SECTION 1 – GENERAL

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
1-i	7/18	1-106	7/15	1-204	7/15
1-ii	1/06	1-107	7/15	1-205	7/15
1-1	7/17	1-108	7/15	1-206	7/15
1-2	7/18	1-109	7/15	1-207	7/15
1-3	7/17	1-110	7/15	1-218	7/15
1-4	7/18	1-111	7/15	1-209	7/15
1-5	7/18	1-112	7/15	1-210	7/15
1-101	7/15	1-113	7/16	1-211	7/15
1-102	7/15	1-114	7/15	1-212	7/15
1-103	7/15	1-201	7/15	1-213	7/15
1-104	7/15	1-202	7/15	1-NOTES	7/18
1-105	7/15	1-203	7/15		

SECTION 2 – POLES/HARDWARE

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
2-i	7/16	2-10	7/14	2-106	7/11
2-ii	7/08	2-11	7/17	2-111	1/07
2-1	7/16	2-12	7/14	2-112	7/11
2-2	7/14	2-13	7/17	2-113	7/17
2-3	7/14	2-14	7/14	2-501	7/18
2-4	7/14	2-15	7/17	2-501B	7/18
2-5	7/14	2-16	7/14	2-502	7/08
2-6	7/15	2-17	7/14	2-503	7/08
2-7	7/14	2-101	7/14	2-504	7/08
2-8	7/14	2-102	7/14	2-NOTES	7/18
2-9	7/14	2-105	7/11		

SECTION 3 – GUYING

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
3-i	7/19	3-23	7/10	3-107Y	7/17
3-ii	7/19	3-24	7/10	3-108D	7/17
3-1	7/19	3-25	7/10	3-108Y	7/17
3-2	7/19	3-26	7/10	3-109D	7/17
3-3	7/19	3-27	7/10	3-109Y	7/17
3-4	7/19	3-28	7/10	3-111	7/17
3-5	7/13	3-29	7/10	3-112	7/10
3-6	7/10	3-30	7/10	3-114	7/09
3-7	7/15	3-31	7/18	3-115D	7/19
3-8	7/15	3-32	7/10	3-115Y	7/19
3-9	7/11	3-33	7/10	3-118	7/17
3-10	7/11	3-34	7/18	3-119	7/17
3-11	7/11	3-35	7/19	3-120	7/17
3-12	7/10	3-36	7/19	3-121	7/17
3-12A	7/18	3-37	7/17	3-122	7/17
3-12B	7/18	3-38	7/10	3-123	7/17
3-13	7/10	3-39	7/10	3-124	7/17
3-14	7/10	3-40	7/10	3-125	7/19
3-15	7/10	3-102	7/16	3-126	7/17
3-16	7/10	3-103	7/16	3-NOTES	7/18
3-17	7/10	3-104	7/16		
3-18	7/10	3-104B	7/16		
3-19	7/10	3-104C	7/16		
3-20	7/10	3-105	7/17		
3-21	7/10	3-106	7/17		
3-22	7/10	3-107D	7/17		

SECTION 4 – STORM HARDENING

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
4-i	7/18	4-4	7/18	4-9	7/18
4-ii	7/18	4-5	7/18	4-10	7/18
4-1	7/18	4-6	7/18	4-11	7/18
4-2	7/18	4-7	7/18	4-NOTES	7/18
4-3	7/18	4-8	7/18		

SECTION 5 – CONNECTORS

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
5-i	7/08	5-121	7/13	5-143	7/13
5-ii	7/08	5-122	1/06	5-144	7/08
5-1	7/17	5-123	7/16	5-147	7/13
5-2	7/12	5-131	7/15	5-148	1/06
5-3	7/12	5-132	1/06	5-149	7/13
5-4	7/08	5-133	7/16	5-NOTES	7/17
5-111	1/06	5-141	7/08		
5-112	1/06	5-142	7/13		

SECTION 6 – PRIMARY CONDUCTORS

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
6-i	7/18	6-116	7/17	6-211	7/10
6-ii	7/18	6-117	7/17	6-212	7/15
6-1	1/07	6-118	7/17	6-213	7/10
6-2	1/07	6-119	7/15	6-214	7/15
6-3	1/07	6-120	7/15	6-215	7/15
6-4	7/17	6-121	7/17	6-216	7/15
6-5	1/07	6-122	7/17	6-217	7/15
6-6	1/07	6-123	7/17	6-218	7/15
6-7	1/07	6-124	7/17	6-219	7/15
6-8	1/07	6-125	7/17	6-220	7/09
6-100	1/07	6-126	7/17	6-300	1/07
6-101	7/15	6-127	7/17	6-301	1/07
6-102	7/15	6-128	7/17	6-302	7/15
6-103	7/15	6-129	7/17	6-303	1/07
6-104	7/15	6-130	7/17	6-304	7/15
6-105	7/17	6-200	1/07	6-305	7/15
6-106	7/17	6-201	7/15	6-306	7/09
6-107	7/17	6-202	7/15	6-307	7/15
6-108	7/17	6-203	7/15	6-308	7/15
6-109	7/17	6-204	1/07	6-309	7/15
6-110	7/17	6-205	7/15	6-310	7/15
6-111	7/17	6-206	7/10	6-311	7/15
6-112	7/15	6-207	7/10	6-312	7/15
6-113	7/17	6-208	7/15	6-313	7/15
6-114	7/17	6-209	7/10	6-314	7/18
6-115	7/17	6-210	7/18	6-NOTES	7/17

SECTION 7 – CLEARANCES

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
7-i	7/18	7-10	7/13	7-21	7/08
7-ii	7/08	7-11	7/13	7-22	7/10
7-1	7/15	7-12	7/13	7-23	7/10
7-2	7/08	7-13	7/08	7-24	7/10
7-3	7/08	7-14	7/08	7-25	7/10
7-4	7/08	7-15	7/08	7-26	7/10
7-5	7/08	7-16	7/16	7-27	7/10
7-6	7/08	7-17	7/17	7-124	7/18
7-7	7/08	7-18	7/08	7-127	1/06
7-8	7/16	7-19	7/18	7-128	1/06
7-9	7/08	7-20	7/10	7-NOTES	7/18

SECTION 8 – COASTLINE CONSTRUCTION

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
8-i	7/13	8-3	7/14	8-7	7/13
8-ii	7/09	8-4	7/14	8-8	7/13
8-1	7/09	8-5	7/13	8-9	7/13
8-2	7/09	8-6	7/13	8-NOTES	7/14

SECTION 9 – PRIMARY

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
9-i	7/17	9-205	7/18	9-437	7/17
9-ii	7/17	9-206	7/17	9-438	7/17
9-iii	7/17	9-411	7/17	9-439	7/17
9-BLANK	7/17	9-411F	7/17	9-440	7/17
9-1	7/17	9-412	7/17	9-441	7/17
9-2	7/17	9-413	7/17	9-711	7/17
9-3	7/17	9-413F	7/17	9-712	7/17
9-4	7/17	9-414	7/17	9-713	7/17
9-5	7/18	9-415	7/17	9-714	7/17
9-6	7/18	9-415F	7/17	9-715	7/17
9-7	7/17	9-416	7/17	9-716	7/17
9-8	7/17	9-416F	7/17	9-719	7/17
9-9	7/17	9-417	7/17	9-720	7/17
9-105	7/17	9-417F	7/17	9-811	7/17
9-115	7/18	9-419 Fig 1	7/17	9-812	7/17
9-118	7/17	9-419 Fig 2	7/17	9-813	7/17
9-120	7/17	9-421 Fig 1	7/17	9-814	7/17
9-122	7/17	9-421 Fig 2	7/17	9-823	7/17
9-124	7/17	9-422	7/17	9-BLANK	7/17
9-200	7/18	9-423 Fig 1	7/17	9-825	7/17
9-201	7/18	9-423 Fig 2	7/17	9-835	7/17
9-202	7/18	9-424	7/17	9-NOTES-1	7/17
9-203	7/18	9-435	7/17	9-NOTES-2	7/17
9-204	7/18	9-436	7/17		

SECTION 10 – SECONDARY

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
10-i	7/18	10-6	7/18	10-100	7/18
10-ii	7/18	10-7	7/18	10-101	7/18
10-1	7/18	10-8	7/18	10-102	7/18
10-2	7/18	10-9	7/18	10-103	7/18
10-3	7/18	10-10	7/18	10-NOTES	7/18
10-4	7/18	10-11	7/18		
10-5	7/18	10-12	7/18		

SECTION 11 – SERVICES

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
11-i	7/18	11-4	7/18	11-122	7/18
11-ii	7/18	11-61	7/18	11-141	7/18
11-1	7/18	11-62	7/18	11-151	7/18
11-2	7/19	11-115	7/18	11-NOTES	7/19
11-3	1/18	11-121	7/18		

SECTION 12 – PROTECTION

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
12-i	7/18	12-130	7/18	12-336	7/18
12-ii	7/18	12-131	7/18	12-337	7/18
12-1	7/17	12-132	7/18	12-337A	7/18
12-2	1/06	12-133A	7/18	12-337B	7/18
12-3	7/07	12-133B	7/18	12-338	7/18
12-4	7/07	12-134	7/18	12-338A	7/18
12-5	7/14	12-135A	7/18	12-338B	7/18
12-6	7/15	12-135B	7/18	12-339	7/18
12-7	6/10	12-136	7/18	12-340	7/18
12-8	6/10	12-137A	7/18	12-340A	7/18
12-9	7/15	12-137B	7/18	12-340B	7/18
12-10	7/18	12-138	7/18	12-341	7/18
12-10A	7/18	12-139	7/18	12-900	7/18
12-11	7/18	12-140	7/18	12-911A	7/18
12-11A	7/18	12-141	7/18	12-911B	7/18
12-12	7/18	12-142	7/18	12-913A	7/18
12-12A	7/18	12-143	7/18	12-914	7/18
12-13	7/17	12-144	7/18	12-938	7/18
12-14	7/18	12-145	7/18	12-950	7/18
12-15	7/16	12-328	7/18	12-950A	7/18
12-16	7/16	12-329	7/18	12-950B	7/18
12-17	7/16	12-330	7/18	12-951	7/18
12-18	7/16	12-331	7/18	12-951A	7/18
12-19	7/18	12-332	7/18	12-951B	7/18
12-20	7/16	12-333	7/18	12-Notes-1	7/18
12-127	7/18	12-334	7/18	12-Notes-2	7/18

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
12-128	7/18	12-335	7/18		
12-129	7/18	12-335A	7/18		

SECTION 13 – GROUNDING

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
13-i	7/14	13-6	7/10	13-112	7/08
13-ii	7/08	13-7	7/10	13-113	7/15
13-1	7/09	13-8	7/10	13-114	7/12
13-2	7/15	13-9	7/15	13-115	7/17
13-3	7/10	13-10	7/10	13-116	7/14
13-4	7/10	13-11	7/10	13-NOTES-1	7/17
13-5	7/10	13-111	7/15	13-NOTES-2	7/15

SECTION 14 – TRANSFORMERS

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
14-i	7/13	14-77	7/08	14-304	7/18
14-ii	7/15	14-78	1/07	14-305	7/12
14-1	7/11	14-79	7/08	14-312	7/18
14-2	7/10	14-80	7/08	14-326	7/18
14-3	7/15	14-81	1/06	14-343	7/15
14-4	7/11	14-121	7/08	14-344	7/08
14-5	7/15	14-131	7/09	14-345	7/15
14-6	7/15	14-132	7/08	14-346	7/08
14-7	1/06	14-171	7/09	14-347	7/10
14-8	7/13	14-172	7/10	14-348	7/15
14-9	1/06	14-173	7/11	14-352	7/18
14-50	7/08	14-174	7/08	14-371	7/18
14-51	7/13	14-175	7/15	14-373	7/11
14-52	7/08	14-176	7/08	14-374	7/11
14-53	7/13	14-177	7/15	14-375	1/06
14-54	7/10	14-204	7/12	14-377	7/16
14-55	10/17	14-212	1/06	14-378	7/18
14-56	1/06	14-247	7/10	14-379	7/17
14-57	1/06	14-248	7/10	14-NOTES-1	7/16
14-58	1/06	14-249	7/10	14-NOTES-2	7/16
14-59	1/06	14-250	7/10		
14-60	1/07	14-252	7/10		
14-61	1/06	14-263	7/08		
14-74	1/06	14-264	1/06		
14-75	1/06	14-271	7/08		
14-76	1/06	14-301	7/10		

SECTION 15 – CAPACITORS / REGULATORS / PRIMARY METERING

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
15-i	7/18	15-156	7/15	15-400	7/12
15-ii	7/16	15-157	7/10	15-401	1/06
15-1	7/09	15-158	7/10	15-402	7/12
15-2	7/18	15-BLANK	7/17	15-403	7/11
15-3	7/18	15-160	7/17	15-404	7/12
15-4	7/18	15-211	7/11	15-405	1/06
15-5	7/18	15-212	7/11	15-406	1/06
15-6	7/18	15-331	7/12	15-407	7/12
15-111	7/10	15-332	7/14	15-409	7/12
15-112	7/09	15-333	7/12	15-500	7/14
15-113	7/09	15-334	7/14	15-501	7/14
15-121	7/09	15-134A	7/17	15-502	7/14
15-122	7/17	15-BLANK	7/17	15-503	7/14
15-131	7/17	15-335	7/14	15-550	7/15
15-151	7/17	15-335A	7/14	15-600	7/16
15-152	7/16	15-336	7/14	15-650	7/16
15-153	7/17	15-336A	7/12	15-NOTES-1	7/18
15-154	7/17	15-363	7/12	15-NOTES-2	7/17
15-155	7/15	15-399	7/10		

SECTION 16 – AERIAL / SPACER CABLE

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
16-i	7/15	16-44	7/12	16-160	7/15
16-ii	7/13	16-45	7/12	16-161	7/15
16-iii	7/15	16-46	7/12	16-163	7/15
16-iv	1/06	16-47	7/15	16-165	7/15
16-1	7/07	16-48	7/15	16-166	7/15
16-2	7/07	16-49	7/15	16-168	7/15
16-3	7/07	16-50	7/15	16-169	7/15
16-4	7/11	16-51	7/15	16-171	7/18
16-5	7/15	16-52	7/15	16-173	7/18
16-6	7/15	16-53	7/15	16-200	1/06
16-7	7/18	16-54	7/15	16-201	7/09
16-8	7/11	16-55	7/15	16-205	7/15
16-9	7/07	16-56	7/15	16-206	7/15
16-10	7/07	16-57	7/15	16-210	7/15
16-11	7/07	16-58	7/15	16-213	7/15
16-12	7/07	16-100	1/06	16-214	7/15
16-13	7/07	16-101	7/15	16-217	7/15
16-14	7/07	16-102	7/15	16-220	7/13
16-15	7/07	16-103	7/15	16-223	7/09
16-16	7/07	16-106	7/15	16-226	7/15
16-17	7/07	16-107	7/15	16-227	7/15
16-18	7/07	16-108	7/15	16-228	7/15
16-19	7/12	16-109	7/15	16-232	7/15
16-20	7/12	16-114	7/15	16-233	7/15
16-21	7/12	16-115	7/15	16-236	7/15
16-22	7/12	16-118	7/09	16-237	7/15
16-23	7/12	16-122	7/09	16-240	7/15
16-24	7/12	16-123	7/09	16-243	7/15
16-25	7/12	16-124	7/07	16-246	7/15
16-26	7/12	16-126	7/09	16-249	7/09
16-27	7/12	16-127	7/09	16-252	7/15
16-28	7/12	16-130	1/06	16-255	7/09
16-29	7/12	16-131	7/15	16-258	7/13
16-30	7/12	16-134	7/09	16-259	7/15
16-31	7/12	16-135	7/10	16-262	7/07
16-32	7/12	16-138	7/15	16-263	7/07
16-33	7/12	16-139	7/10	16-265	7/18
16-34	7/12	16-142	7/15	16-300	1/06
16-35	7/12	16-143	7/15	16-301	7/07
16-36	7/12	16-146	7/15	16-305	7/07
16-37	7/12	16-148	7/15	16-310	7/09
16-38	7/12	16-150	7/15	16-315	7/07
16-39	7/12	16-151	7/15	16-320	7/07
16-40	7/12	16-153	7/15	16-321	7/07
16-41	7/12	16-155	7/10	16-NOTES	7/15
16-42	7/12	16-157	7/15	16-NOTES	7/15
16-43	7/12	16-158	7/15		

SECTION 17 – JOINT USE

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
17-i	7/16	17-101	7/10	17-113	7/10
17-ii	1/16	17-102	7/10	17-114	7/10
17-1	7/07	17-103	7/10	17-115	7/10
17-2	7/16	17-105	1/06	17-116	7/10
17-3	7/16	17-107	1/06	17-117	7/10
17-4	7/10	17-108	7/07	17-118	7/07
17-5	7/10	17-109	7/16	17-119	7/07
17-6	7/07	17-110	7/10	17-NOTES	7/16
17-7	7/07	17-111	7/10		
17-100	7/07	17-112	7/10		

SECTION 18 – RISERS

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
18-i	7/18	18-116	7/18	18-341	7/18
18-ii	7/18	18-117	7/18	18-353	7/18
18-1	7/11	18-118	7/18	18-370	7/18
18-2	7/14	18-124	7/18	18-400	7/18
18-3	7/18	18-124M	7/18	18-400M	7/18
18-4	7/18	18-125	7/18	18-405	7/18
18-5	7/11	18-125M	7/18	18-734	7/18
18-6	7/16	18-126	7/18	18-735	7/18
18-7	7/14	18-126D	7/18	18-736	7/18
18-BLANK	7/12	18-BLANK	7/18	18-737	7/18
18-104	7/18	18-127	7/18	18-738	7/18
18-107	7/18	18-128	7/18	18-739	7/18
18-109	7/18	18-335	7/18	18-1273A	7/18
18-110	7/18	18-336	7/18	18-1277A	7/18
18-111	7/18	18-336D	7/18	18-1277B	7/18
18-112	7/18	18-337	7/18	18-BLANK	7/18
18-115	7/18	18-338	7/18	18-NOTES	7/18
18-115B	7/18	18-340	7/18	18-NOTES	7/18

SECTION 19 – LIGHTING

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
19-i	7/17	19-9	7/17	19-121	7/13
19-ii	7/15	19-10	7/17	19-122	7/13
19-1	7/17	19-11	7/17	19-130	7/15
19-2	7/17	9-12	7/17	19-131	7/15
19-3	7/15	19-100	7/13	19-140	7/15
19-4	7/15	19-101	7/13	19-141	7/13
19-5	7/17	19-110	7/15	19-150	7/13
19-6	7/17	19-111	7/15	19-151	7/13
19-7	7/15	19-112	7/13	19-152	7/13
19-8	7/17	19-120	7/15	19-NOTES	7/17

SECTION 20 – 25-35 KV DISTRIBUTION PRIMARY

Page Number	Issue Date	Page Number	Issue Date	Page Number	Issue Date
20-i	7/18	20-200	7/07	20-421 Fig 1	7/07
20-ii	7/07	20-201	7/07	20-421 Fig 2	7/07
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20-6	7/07	20-206	7/18	20-438	7/07
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20-9	7/07	20-413	7/07	20-441	7/07
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1.2 TRANSMISSION VOLTAGES

This is a list of nominal transmission system voltages presently in use within the PPL Service Territory. All voltages are 60 Hz unless otherwise noted. Non-standard service voltages are followed by an asterisk (*).

Voltage	Operating Location
69,000	RI
115,000	RI
345,000	RI

1.3 PRIMARY DISTRIBUTION VOLTAGES

These are lists of nominal primary distribution system voltages presently in use within the PPL Service Territory. All voltages are 60 Hz unless otherwise noted. Non-standard service voltages are followed by an asterisk (*).

1.3.10 3-Phase, 3 Wire

Voltage	BIL (kV)	Voltage Code	Operating Location
2,400Δ *	75	H	RI
11,000Δ	95		RI (Note 1)
23,000Y	125		RI
23,000Δ	150		RI
34,500Y *	150		RI (Note 2)

Notes:
1. In Providence, RI, Non-effectively grounded supply.
2. In southern RI, 34.5 kV 3-phase, 3-wire supply.

1.3.20 3-Phase, 4 Wire

Voltage	BIL (kV)	Voltage Code	Operating Location
4,160GRDY/2,400	75	J	RI
12,470GRDY/7,200	95	F	RI
13,800GRDY/7,960	95	W	RI
34,500GRDY/19,900	150	T	RI

1.4 SECONDARY DISTRIBUTION VOLTAGES, SINGLE PHASE

1.4.10 2 Wire

Voltage
120 (Note 1)
240 (Note 1)

1.4.10 3 Wire

Voltage
120/240
120/208 (Note 2)

Notes:
1. For lighting only.
2. Underground Network

1.5 SECONDARY DISTRIBUTION VOLTAGES, THREE PHASE

1.5.10 3 Wire

Voltage
240 *
480 *
600 *

1.5.20 4 Wire

Voltage
125/216Y (Note 1)
208Y/120
240/120 (Note 2)
480Y/277

Notes:
1. Underground Network
2. 240 V open or closed Delta with 120 V for lighting.

1.6 CONSTRUCTION GUIDELINES FOR COMPLIANCE FOR DISTRIBUTION AND SUB TRANSMISION STANDARDS

As part of the construction audit review, questions have been raised as to when existing construction shall be brought in compliance with current Distribution Standards. The following is a general outline as to what the Company expectations are with regard to this matter.

New Construction – All new construction shall be built to current PPL Distribution Standards.

Existing Construction – Existing construction or maintenance work (i.e., outside of complete structure replacement, reconductoring or conversions) does not require that the existing structure be brought in compliance with the current Distribution Standards provided that the work being done maintains the integrity of the original structure's construction. Safety concerns (such as clearances) or potential reliability issues at the structure shall be addressed as part of the work that is being performed.

Emergency Construction – Emergency or temporary construction does not require that the existing structure be brought in compliance with the current Distribution Standards provided that the work being done maintains the integrity of the original structure's construction. Critical safety concerns that may result in undue hazard or potential harm to Company personnel or to the general public shall be addressed as part of the emergency work that is being performed. Potential reliability issues or general safety concerns at the structure shall be reported to local supervision. Emergency or temporary construction shall be brought into compliance with Distribution Standards as soon as practical.

Note 1: During structure replacement, reconductoring, or conversion work, all minimum clearances and separations per current Distribution Standards shall be followed.

Note 2: In all cases, work being completed on any given structure shall be in compliance with PPL Electric Operating Procedures as well as all applicable federal, state or local law / ordinance. (e.g., For the case where a driven ground rod is found to be missing on a required structure, appropriate permissions (e.g., Dig Safe, Dig Safely) must be acquired prior to correcting the situation.)

Some examples of safety or potential reliability concerns include, but are not limited to:

- ***Safety***
  - Clearances
  - Potted porcelain cutout on pole
  - *Missing guy marker(s)*
  - *Missing structure or switch number*
  - Missing equipment locks

- **Reliability**
  - Improper bonding and grounding
  - Missing or exposed ground rod(s)
  - Street lighting
  - Metallic Riser conduits
  - Guy wire (wye system)
  - Switch handles
  - Control cabinets
  - Equipment tank/mounts
  - Spacer cable supports (tangent, C and E-brackets)
  - Arresters (flexible braid utilized for arrester disconnector)
  - Secondary neutral

- Down ground molding
- Potted porcelain cutout on pole
- Missing surge arrester(s)
- Missing animal guard(s)

These abbreviations are taken from ANSI Standard Y1.1 and other standards organizations. The asterisk (*) denotes terms deemed necessary but not acceptable or defined by the above mentioned standards. The left column lists words/phrases while the right column lists the abbreviation.

A

ADJUST, ADJUSTING, ADJUSTABLE	ADJ	A	AMPERE
AIR BREAK SWITCH	ABS	*A/C	AIR CONDITIONER
AIR CIRCUIT BREAKER	ACB	AAAC	ALL ALUMINUM ALLOY CONDUCTOR
* AIR CONDITIONER	A/C	AAC	ALL ALUMINUM CONDUCTOR
AL CONDUCTOR STEEL REINFORCED	ACSR	AB	ANCHOR BASE
ALL ALUMINUM ALLOY CONDUCTOR	AAAC	ABS	AIR BREAK SWITCH
ALL ALLUMINUM CONDUCTOR	AAC	AC	ALTERNATING CURRENT
ALTERNATING CURRENT	AC	ACB	AIR CIRCUIT BREAKER
ALUMINUM	AL	ACSR	AL CONDUCTOR STEEL REINFORCED
ALUMOWELD	AW	ADJ	ADJUST, ADJUSTING, ADJUSTABLE
ALUMOWELD ALUMINUM CONDUCTOR	AWAC	AL	ALUMINUM
AMERICAN WIRE GAUGE	AWG	AMP	AMPERE
AMPERE	AMP, A	APPROX	APPROXIMATE
ANCOR BASE	AB	ARR	ARRESTER
AND SO FORTH	ETC	ASYM	ASYMMETRICAL
APPROXIMATE	APPROX	AUTO	AUTOMATIC
ARRESTER	ARR	AUX	AUXILIARY
ASYMMETRICAL	ASYM	AVE	AVENUE
AUTOMATIC	AUTO	AVG	AVERAGE
AUXILIARY	AUX	AW	ALUMOWELD
AVENUE	AVE	AWAC	ALUMOWELD ALUMINUM CONDUCTOR
AVERAGE	AVG	AWG	AMERICAN WIRE GAUGE

B

BASIC INSULATION IMPULSE LEVEL	BIL	B	BLACK
BLACK	BLK, B	BIL	BASIC INSULATION IMPULSE LEVEL
BLUE	BLU, BL	BL	BLUE
BOLT	BLT	BLDG	BUILDING
BRACKET	BRKT	BLK	BLACK
BRASS	BRS	BLT	BOLT
BRITISH THEMAL UNIT	BTU	BLU	BLUE
BRONZE	BNZ	BNZ	BRONZE
BROWN	BRN,BR	BR	BROWN
BUILDING	BLDG	BRKT	BRACKET
BY PASS	BYP	BRN	BROWN
		BRS	BRASS
		BTU	BRITISH THERMAL UNIT
		BYP	BY PASS

C			
CAPACITOR	CAP	C TO C	CENTER TO CENTER
CATALOGUE	CAT	CAP	CAPACITOR
CENTER	CTR	CC	CUBIC CENTIMETER
CENTER LINE	CL	CFM	CUBIC FEET PER MINUTE
CENTER TO CENTER	C TO C	CIR	CIRCLE, CIRCULAR
CENTIGRADE	° C	CKT	CIRCUIT
CIRCLE, CIRCULAR	CIR	CL	CENTER LINE
CIRCUIT	CKT	CL	CLASS, CLASSIFICATION
CLAMP	CLP	CLF	CURRENT-LIMITING FUSE
CLASS, CLASSIFICATION	CL	CLP	CLAMP
COMPANY	CO	CNDCT	CONDUCTOR
COMPATIBLE UNIT	CU	CO	COMPANY
* COMPRESS, COMPRESSION	COMP	CO	CUTOUT
COMPLETELY SELF-PROTECTED	CSP	*COMP	COMPRESS, COMPRESSION
* CONCENTRIC	CONC	*CONC	CONCENTRIC
CONDUCTOR	CNDCT	CONN	CONNECTOR, CONNECTION, CONNECT
CONDUCTOR, MULTIPLE “EXAMPLE”	3/C	CORP	CORPORATION
* CONDUCTORS PARALLELED	CP	COV	COVER, COVERED
* CONDUCTORS TWISTED	CT	*CP	CONDUCTORS PARALLELED
CONNECTOR, CONNECTION, CONNECT	CONN	CSP	COMPLETELY SELF-PROTECTED
COPPER	CU	*CT	CONDUCTORS TWISTED
COPPERWELD	CW	CT	CURRENT TRANSFORMER
* COPPERWELD-COPPER	CCW	CTR	CENTER
CORPORATION	CORP	CU	COMPATIBLE UNIT
COVER, COVERED	COV	CU	COPPER
CROSS LINK POLYETHYLENE	XLP	CU FT	CUBIC FEET
CROSS SECTION	XSECT	CU IN	CUBIC INCH
CROSSARM	XARM	CU M	CUBIC METERS
CUBIC CENTIMETER	CC	CU YD	CUBIC YARDS
CUBIC FEET PER MINUTE	CFM	*CUST	CUSTOMER
CUBIC FEET	CU FT	CW	COPPERWELD
CUBIC INCH	CU IN	*CWCU	COPPERWELD-COPPER
CUBIC METER	CU M	CY	CYCLE
CUBIC YARD	CU YD		
CURRENT-LIMITING FUSE	CLF		
CURRENT TRANSFORMER	CT		
* CUSTOMER	CUST		
CUTOUT	CO		
CYCLE	CY		

D			
* DEADEND	DE	D	DEPTH
DELTA	Δ	*DB	DIRECT BURIED
DEPARTMENT	DEPT	DBL	DOUBLE
DEPTH	D	DC	DIRECT CURRENT
DIAMETER	DIA	*DE	DEAD END
* DIRECT BURIED	DB	DEPT	DEPARTMENT
DIRECT CURRENT	DC	DF	DOUGLAS FIR
DISCONNECT	DISC	DIA	DIAMETER
DISTRIBUTE, DISTRIBUTION	DISTR	DISC	DISCONNECT
DOUBLE	DBL	DISTR	DISTRIBUTE, DISTRIBUTION
DOUBLE POLE SWITCH	DP SW	DN	DOWN
DOUGLAS FIR	DF	DP SW	DOUBLE POLE SWITCH
DOWN	DN	*DPX	DUPLEX
* DUPLEX	DPX		
E			
EACH	EA	E	EAST
EAST	E	EA	EACH
* EIGHT HOLE	8H	EC	ELECTRICAL CONDUCTOR
ELBOW	ELB	EG	FOR EXAMPLE
ELECTRIC, ELECTRICAL, ELECTRONIC	ELEC	EHV	EXTRA HIGH VOLTAGE
ELECTRICAL CONDUCTOR	EC	ELB	ELBOW
EMBEDDED	EMB	ELEC	ELECTRIC, ELECTRICAL, ELECTRONIC
ENGINEER, ENGINEERING	ENGR	EMB	EMBEDDED
ENTRANCE	ENTR	ENCL	ENCLOSED, ENCLOSURE
EQUIPMENT	EQPT	ENGR	ENGINEER, ENGINEERING
EQUIVALENT	EQUIV	ENTR	ENTRANCE
ETHYLENE PROPYLENE	EP	*EP	ETHYLENE PROPYLENE
* ETHYLENE PROPYLENE RUBBER	EPR	*EPR	ETHYLENE PROPYLENE RUBBER
* EXTRA HIGH VOLTAGE	EHV	EQPT	EQUIPMENT
		EQUIV	EQUIVALENT
		ETC	AND SO FORTH

F			
FAHRENHEIT	° F	FC	FOOT CANDLE
FEEDER	FDR	FDR	FEEDER
FEET	FT, '	*FG	FIBERGLASS
* FIBERGLASS	FG	FIG	FIGURE
FIGURE	FIG	FLDT	FLOODLIGHT
FLOODLIGHT	FLDT	FOA	FORCED OIL W/ FORCED AIR COOLER
FOOT	FT, '	FREQ	FREQUENCY
FOOT CANDLE	FC	FT	FOOT, FEET
FOOT POUNDS	FT-LB	FT-LB	FOOT POUND
FOR EXAMPLE	EG	*FTN	FULL TENSION
FORCED OIL W/FORCED AIR COOLER	FOA		
FOUR CONDUCTORS	4/C		
* FOUR CONDUCTORS PARALLELED	4CP		
* FOUR CONDUCTORS TWISTED	4CT		
FREQUENCY	FREQ		
* FULL TENSION	FTN		
G			
GALLON	GAL	GAL	GALLON
GALLONS PER HOUR	GPH	GALV	GALVANIZED
GALLONS PER MINUTE	GPM	GALVI	GALVANIZED IRON
GALLONS PER SECOND	GPS	GALVS	GALVANIZED STEEL
GALVANIZED	GALV	GND	GROUND
GALVANIZED IRON	GALVI	GP	GENERAL PURPOSE
GALVANIZED STEEL	GALVS	GPH	GALLONS PER HOUR
GENERAL PURPOSE	GP	GPM	GALLONS PER MINUTE
GRAY	GRA, GY	GPS	GALLONS PER SECOND
GREEN	GRN	GRA	GRAY
GROUND	GND	GRN	GREEN
		GY	GRAY
H			
HANDHOLE	HH	H	HEIGHT
HARD DRAWN	HD DRN	HD	HEAVY DUTY
HARDWARE	HDW	*HD	HIGH DENSITY
HEAVY DUTY	HD	HD DRN	HARD DRAWN
HEIGHT	H	*HDPE	HIGH DENSITY POLYETHYLENE
HERTZ	HZ	*HDTR	HIGH DENSITY TRACK RESISTANT
* HIGH DENSITY	HD	HDW	HARDWARE
* HIGH DENSITY POLYETHYLENE	HDPE	HH	HANDHOLE
* HIGH DENSITY TRACK RESISTANT	HDTR	*HMP	HIGH MOLECULAR POLYETHYLENE
* HIGH MOLECULAR POLYETHYLENE	HMP	HORIZ	HORIZONTAL
HIGH PRESSURE	HP	HP	HIGH PRESSURE
HIGH PRESSURE SODIUM VAPOR	HPS	HP	HORSEPOWER
HIGH TENSION	HT	HPS	HIGH PRESSURE SODIUM VAPOR
HIGH VOLTAGE	HV	HT	HIGH TENSION
HIGHWAY	HWY	HV	HIGH VOLTAGE
HORIZONTAL	HORIZ	HWY	HIGHWAY
HORSEPOWER	HP	HZ	HERTZ

I			
IMPEDANCE	IMPD	ID	INSIDE DIAMETER
INCANDESCENT	INCAND	I.E.	THAT IS
INCH	IN, “	IMPD	IMPEDANCE
INCHES PER SECOND	IPS	IN	INCH
INDUCTION, INDUCTANCE	IND	INCAND	INCANDESCENT
INFORMATION	INFO	*IND	INDUCTION, INDUCTANCE
INSIDE DIAMETER	ID	INFO	INFORMATION
INSTANTANEOUS	INST	INST	INSTANTANEOUS
INSULATE, INSULATING, INSULATOR	INSUL	INSUL	INSULATE, INSULATING, INSULATOR
INTERRUPT	INTRPT	INTRPT	INTERRUPT
		IPS	INCHES PER SECOND
J			
* JOINTLY OWNED	JO	JCT	JUNCTION
* JUMPER	JMP	*JMP	JUMPER
JUNCTION	JCT	*JO	JOINTLY OWNED
K			
KILOVAR	KVAR	K	THOUSAND
KILOVOLT	KV	KCMIL	THOUSAND CIRCULAR MILS
KILOVOLT-AMPERE	KVA	KV	KILOVOLT
KILOWATT	KW	KVA	KILOVOLT-AMPERE
KILOWATT HOUR	KWH	KVAR	KILOVAR
		KW	KILOWATT
		KWH	KILOWATT HOUR

L			
LARGE	LGE	L	LENGTH
LEAD COVERED	LC	*L	LUMEN
LEAD OVER HEIGHT	L/H	L/H	LEAD OVER HEIGHT
LENGTH	L	LB	POUND
LIGHT	LT	*LBK	LOAD BREAK
LIGHT EMITTING DIODE	LED	*LBS	LOAD BREAK SWITCH
LIGHTING	LTG	LBS	POUNDS
LIMITER	LMTR	LC	LEAD COVERED
* LOAD BREAK	LBK	LED	LIGHT EMITTING DIODE
* LOAD BREAK SWITCH	LBS	LGE	LARGE
* LOAD TAP CHANGER	LTC	LIM	LIMIT
LOW VOLTAGE	LV	LMTR	LIMITER
LUBRICATED, LUBRICATION	LUB	LPW	LUMENS PER WATT
* LUMEN	L	LT	LIGHT
LUMENS PER WATT	LPW	*LTC	LOAD TAP CHANGER
* LUMINAIRE	LUM	LTG	LIGHTING
		LUB	LUBRICATED, LUBRICATION
		*LUM	LUMINAIRE
		LV	LOW VOLTAGE

M			
MACRO UNIT	MU	M	THOUSAND POUNDS (GUY STRANDS)
MAINTENANCE	MAINT	MA	MILLIAMPERE
MANHOLE	MH	MAINT	MAINTENANCE
MANUFACTURE, MANUFACTURER	MFR	MATL	MATERIAL
MATERIAL	MATL	MAX	MAXIMUM
MATERIAL LIST	ML	*MBS	MINIMUM BREAKING STRENGTH
MAXIMUM	MAX	MCY	MEGACYCLE
* MEDIUM HARD DRAWN	MHD	*MEG	MEGAOHM
* MEGACYCLE	MCY	MESS	MESSEMGER
* MEGAWATT	MWT	MFR	MANUFACTURE, MANUFACTURER
* MEGAWATT HOUR	MWH	MGY	MULTIGROUNDED-Y CONNECTED
* MEGAOHM	MEG	MH	MANHOLE
* MERCURY VAPOR	MV	MH	PROBE START METAL HALIDE
MESSENGER	MESS	*MHD	MEDIUM HARD DRAWN
METAL-OXIDE VERISTER	MOV	MIN	MINIMUM
METER, METERING	MTR	MISC	MISCELLANEOUS
MILLIAMPERE	MA	ML	MATERIAL LIST
MILLION VOLT AMPERES	MVA	MOV	METAL-OXIDE VERISTER
MINIMUM	MIN	MT	MOUNT
* MINIMUM BREAKING STRENGTH	MBS	MTG	MOUNTING
MISCELLANEOUS	MISC	MTR	METER, METERING
MOUNT	MT	MU	MACRO UNIT
MOUNTING	MTG	*MV	MERCURY VAPOR
MULTIGROUNDED-Y CONNECTED	MGY	MVA	MILLION VOLT AMPERES
		*MHW	MEGAWATT-HOUR
		*MWT	MEGAWATT

N			
NEGATIVE	NEG	N	NORTH
* NEOPRENE	NEO	NC	NORMALLY CLOSED
NETWORK	NTWK	NEG	NEGATIVE
NEUTRAL	NEUT	*NEO	NEOPRENE
* NICOPRESS	NICPRS	NEUT	NEUTRAL
NOMINAL	NOM	*NICPRS	NICOPRESS
NORMALLY CLOSED	NC	NO	NORMALLY OPEN, NUMBER
NORMALLY OPEN	NO	NOM	NOMINAL
NORTH	N	NTWK	NETWORK
NUMBER	NO, #		
O			
OBSOLETE	OBS	OBS	OBSOLETE
OHM	Ω	OCB	OIL CIRCUIT BREAKER
OIL CIRCUIT BREAKER	OCB	OD	OUTSIDE DIAMETER
ONE CONDUCTOR	1/C	*OH	OVERHEAD
OUNCE	OZ	OVLD	OVERLOAD
OUTSIDE DIAMETER	OD	OZ	OUNCE
* OVERHEAD	OH		
OVERLOAD	OVLD		

P			
* PAPER & LEAD	PL	P	PHASE
PARALLEL	PRL	P	POLE
* PARALLEL GROOVE	PG	*PB	PUSH BRACE
* PARTIAL TENSION	PTN	PCT	PERCENT
PEDESTRIAN	PED	PE	PHOTOELECTRIC CON
PERCENT	PCT	PE	POLYETHYLENE
PHASE	P, Ø	PEC	PHOTO ELECTRIC CONTROL
PHOTO ELECTRIC CONTROL	PEC	PECR	PHOTO ELECTRIC CONTROL RECEPTACLE
PHOTO ELECTRIC CONTROL RECEPTACLE	PECR	PED	PEDESTRIAN
PHOTOELECTRIC CONTROL	PE	PF	POWER FACTOR
PINT	PT	*PG	PARALLEL GROOVE
POINT	PT	*PISA	POWER INSTALLED SCREW ANCHOR
POLE	P	*PL	PAPER & LEAD
* POLE MOUNT	PMNT	PLD	PLATED
* POLE TOP EXTENSION	PTX	*PMNT	POLE MOUNT
POLYCARBONATE	POLYCAR	*POLY	POLYETHELENE
* POLYETHELENE	POLY,PE	POLYCAR	POLYCARBONATE
POLYVINYL CHLORIDE	PVC	PORC	PORCELAIN
PORCELAIN	PORC	POS	POSITIVE
POSITIVE	POS	POT	POTENTIAL
POST TOP	PT	PRCST	PRECAST
POTENTIAL	POT	PREFMD	PREFORMED
POTENTIAL TRANSFORMER	PT	PRESS	PRESSURE
POUND	LB	PRI	PRIMARY
POUNDS	LBS	PRL	PARALLEL
POWER	PWR	PSMH	PULSE START METAL HALIDE
POWER FACTOR	PF	PT	PINT
*POWER INSTALLED SCREW ANCHOR	PISA	PT	POINT
PRECAST	PRCST	PT	POST TOP
PREFORMED	PREFMD	PT	POTENTIAL TRANSFORMER
PRESSURE	PRESS	*PTN	PARTIAL TENSION
PRIMARY	PRI	*PTX	POLE TOP EXTENSION
PROBE START METAL HALIDE	MH	PVC	POLYVINYL CHLORIDE
PULSE START METAL HALIDE	PSMH	PWR	POWER
* PUSH BRACE	PB		
Q			
QUADRANT	QDRNT	QDRNT	QUADRANT
* QUARDUPLEX	QPX	*QPX	QUADRUPLEX
QUANTITY	QTY	QT	QUART
QUART	QT	QTY	QUANTITY

R			
* RADIAL, RADIUS	RAD	R	RIGHT
RAILROAD	RR	R/W	RIGHT OF WAY
* REACTANCE/RESISTANCE	X/R	*RAD	RADIAL, RADIUS
* REACTANCE	X	RC	REMOTE CONTROL
REACTOR BALLAST	REA	RCPT	RECEPTACLE
REACTOR, REACTIVE	REAC	RD	ROAD
RECEPTACLE	RCPT	RDC	REDUCE, REDUCER, REDUCING
RECLOSER, RECLOSING	REC	RDWY	ROADWAY
REDUCE, REDUCER, REDUCING	RDC	REA	REACTOR BALLAST
REFLECTOR	REFL	REAC	REACTOR, REACTIVE
* REFRACTOR	REFC	REC	RECLOSER, RECLOSING
REGULAR	RGLR	*REFC	REFRACTOR
REGULATED BALLAST	REG	REFL	REFLECTOR
* REGULATOR	REG	REG	REGULATED BALLAST
REMOTE CONTROL	RC	*REG	REGULATOR
REPORT	RPRT	RES	RESISTANCE, RESISTOR
RESISTANCE, RESISTOR	RES	REV	REVISE, REVISION
REVISE, REVISION	REV	*RGBL	RIGID BAIL
RIGHT	RT, R	RGD	RIGID
RIGHT HAND	RH	RGLR	REGULAR
RIGHT OF WAY	R/W	RH	RIGHT HAND
RIGID	RGD	RMS	ROOT MEAN SQUARE
* RIGID BAIL	RGBL	RND	ROUND
ROAD	RD	RPRT	REPORT
ROADWAY	RDWY	RR	RAILROAD
ROOT MEAN SQUARE	RMS	RT	RIGHT
ROUND	RND	RUB	RUBBER
RUBBER	RUB		

S			
SECOND, SECONDARY	SEC	S	SOUTH
SECTION, SECTIONAL	SECT	SB	SILICON BRONZE
SECTIONALIZER	SECT	*SBLT	SPLIT BOLT
SELF-SUPPORTING	SS	SD	SOFT DRAWN
SEMI-FLEXIBLE BAIL	SFB	SEC	SECOND, SECONDARY
SERIES	SER	SECT	SECTION, SECTIONAL
SERVICE	SVCE	SECT	SECTIONALIZER
SILICON BRONZE	SB	SER	SERIES
SINGLE	SGL	SFB	SEMI-FLEXIBLE BAIL
SINGLE CONDUCTOR	1/C	SGL	SINGLE
SINGLE HOLE	1H	SO	SOLELY OWNED
SINGLE PHASE	1PH, 1Ø	SOD	SODIUM
* SINGLE POLE	1P	SOL	SOLID
SINGLE POLE DOUBLE THROW	SPDT	*SP	SOUTHERN PINE
SINGLE POLE SINGLE THROW	SPST	*SPA	SOUTHERN PINE ASPHALT
SINGLE POLE SWITCH	SP SW	*SPC	SOUTHERN PINE CREOSOTE
* SINGLE STRAND EYE	SSE	*SPCA	SPACER CABLE
SIX CONDUCTORS TWISTED	6CT	*SPCT	SOUTHERN PINE-CELLON TREATMENT
SIX HOLE	6H	SPCR	SPACER
SODIUM	SOD	SPDT	SINGLE POLE DOUBLE THROW
SOFT DRAWN	SD	SPEC	SPECIFICATION
SOLELY OWNED	SO	SPPC	SOUTHERN PINE-CELLON TREATMENT
SOLID	SOL	SPST	SINGLE POLE SINGLE THROW
SOUTH	S	SP SW	SINGLE POLE SWITCH
SOUTHERN PINE	SP	*SQU	STRAIN QUADRANT
* SOUTHERN PINE ASPHALT	SPA	SS	SELF SUPPORTING
* SOUTHERN PINE CREOSOTE	SPC	*SSE	SINGLE STRAND EYE
* SOUTHERN PINE PENTA IN CREOSOTE	SPPC	SPPC	SOUTHERN PINE-CELLON TREATMENT
* SOUTHERN PINE-CELLON TREATMENT	SPCT	SST	STAINLESS STEEL
SPACER	SPCR	*SST	STRAIN STRAIGHT
* SPACER CABLE	SPCA	STA	STATION, STATIONARY
SPECIFICATION	SPEC	STD	STANDARD
* SPLIT BOLT	SBLT	STL	STEEL
STAINLESS STEEL	SST	*ST LT	STREET LIGHT
STANDARD	STD	STR	STRAND, STRANDED
STATION, STATIONARY	STA	STRN	STRAIN
STEEL	STL	*SUB	SUBSTATION
STRAIN	STRN	SUPV	SUPERVISE, SUPERVISORY
* STRAIN QUADRANT	SQU	SUSP	SUSPENSION
* STRAIN STRAIGHT	SST	SVCE	SERVICE
STRAND, STRANDED	STR	SW	SWITCH, SWITCHED
* STREET LIGHT	ST LT	SWGR	SWITCHGEAR
* SUBSTATION	SUB	SYM	SYMBOL
SUPERVISE, SUPERVISORY	SUPV	SYMM	SYMMETRIC, SYMMETRICAL
* SUSPENSION	SUSP	SYS	SYSTEM
SWITCH, SWITCHED	SW		
SWITCHGEAR	SWGR		
SYMBOL	SYM		
SYMMETRIC, SYMMETRICAL	SYMM		
SYSTEM	SYS		

T			
TANGENT	TAN	TAN	TANGENT
TEARDROP	TDROP	TBASE	TRANSFORMER BASE
TEMPERATURE	TEMP	TCC	TIME-CURRENT CURVE
TERMINAL, TERMINATOR	TERM	TD	TIME DELAY
THAT IS	I.E.	TDROP	TEARDROP
* THERMOPLASTIC	THPL	*TEA	TRIPLE EYE ANCHOR ROD
THOUSAND	K	TEMP	TEMPERATURE
THOUSAND CIRCULAR MILS	KCMIL	TERM	TERMINAL, TERMINATOR
THOUSAND POUNDS (GUY STRAND)	M	*TES	TRIPLE EYE SCREW ANCHOR
THREAD, THREADED	THD	THD	THREAD, THREADED
THREE CONDUCTOR	3/C	*THDLES	THREADLESS
* THREE CONDUCTORS PARALLELED	3CP	*THPL	THERMOPLASTIC
* THREE CONDUCTORS TWISTED	3CT	THRU	THROUGH
THROUGH	THRU	TND	TINNED
TIME-CURRENT CURVE	TCC	TPL	TRIPLE
TIME DELAY	TD	TR	TRACK RESISTANT
TINNED	TND	TRX	TRIPLEX
TRACK RESISTANT	TR	*TSE	TRIPLE STRAND-EYE
TRANSFORMER	XFMR		
TRANSFORMER BASE	TBASE		
TRANSMISSION	XSMN		
TRIPLE	TPL		
* TRIPLE EYE ANCHOR ROD	TEA		
* TRIPLE EYE SCREW ANCHOR	TES		
TRIPLE POLE DOUBLE THROW	3PDT		
TRIPLE POLE SINGLE THROW	3PST		
TRIPLE POLE SWITCH	3P SW		
* TRIPLE STRAND-EYE	TSE		
TRIPLEX	TRX		
TWO CONDUCTORS	2/C		
* TWO CONDUCTORS PARALLELED	2CP		
* TWO CONDUCTORS TWISTED	2CT		
* TWO HOLE	2H		
TWO POLE	2P		
U			
ULTRAVIOLET LIGHT	UV	*UG	UNDERGROUND
* UNDERGROUND	UG	UGY	UNGROUNDED-Y CONNECTION
UNGROUNDED-Y CONNECTION	UGY	UNIV	UNIVERSAL
UNIVERSAL	UNIV	UV	ULTRAVIOLET LIGHT
V			
VACUUM	VAC	V	VOLT
VARNISHED CAMBRIC	VC	VA	VOLT AMPERE
* VAULT	VLT	VAC	VACUUM
VERTICAL	VERT	VC	VARNISHED CAMBRIC
* VINYL	VYL	VERT	VERTICAL
VOLT	V	*VLT	VAULT
VOLT AMPERE	VA	VOL	VOLUME
VOLUME	VOL	*VYL	VINYL

W			
WATT	W	W	WATT
WATT HOUR	WHR	W	WEST
WATT HOUR METER	WHM	W	WHITE
WATTMETER	WM	W	WIDTH
WEATHERPROOF	WP	W/	WITH
WEEK	WK	W/B	WITH BRACKET
WEIGHT	WT	WD	WIDTH
WEST	W	WD	WOOD
WHITE	WHT, W	WHM	WATT HOUR METER
WIDTH	WD, W	WHR	WATT HOUR
WITH	W/	WHT	WHITE
WITH BRACKET	W/B	WK	WEEK
* WITHOUT	WO/	WM	WATT METER
WOOD	WD	*WO/	WITHOUT
WYE	Y	WP	WEATHERPROOF
		WT	WEIGHT
X			
		*X	REACTANCE
		X	STRAND
		*X/R	REACTANCE/RESISTANCE
		XARM	CROSSARM
		XFMR	TRANSFORMER
		XLP	CROSS LINK POLYETHYLENE
		XSECT	CROSS SECTION
		XSMN	TRANSMISSION
Y			
YARD	YD	Y	WYE
YARDS	YDS	Y	YELLOW
YEAR	YR	YD	YARD
YELLOW	YEL, Y	YDS	YARDS
		YEL	YELLOW
		YR	YEAR
Z			
ZINC	ZN	ZN	ZINC
* ZINC PLATED	ZP	*ZP	ZINC PLATED

SPECIAL CHARACTERS

1/C	ONE CONDUCTOR		
1/C	SINGLE CONDUCTOR		
1/H	ONE HOLE		
*1/H	SINGLE HOLE		
1P	ONE POLE		
1P	SINGLE POLE		
1PH	SINGLE PHASE		
1Ø	SINGLE PHASE		
2/C	TWO CONDUCTOR		
*2CP	TWO CONDUCTORS PARALLELED		
*2CT	TWO CONDUCTORS TWISTED		
*2H	TWO HOLE		
2P	TWO POLE		
3/C	THREE CONDUCTOR		
*3CP	THREE CONDUCTORS PARALLELED		
*3CT	THREE CONDUCTORS TWISTED		
3P	THREE POLE		
3P SW	TRIPLE POLE SWITCH		
3PDT	TRIPLE POLE DOUBLE THROW SW		
3PST	TRIPLE POLE SINGLE THROW SW		
4/C	FOUR CONDUCTOR		
*4CP	FOUR CONDUCTORS PARALLELED		
*4CT	FOUR CONDUCTORS TWISTED		
*4H	FOUR HOLE		
4P	FOUR POLE		
4P SW	FOUR POLE SWITCH		
4PDT	FOUR POLE DOUBLE THROW SW		
4PST	FOUR POLE SINGLE THROW SW		
6CT	SIX CONDUCTORS TWISTED		
6H	SIX HOLE		
*8H	EIGHT HOLE		
∆	DELTA		
Ω	OHM		
Ø	PHASE		
‘	FOOT OR FEET		
“	INCH OR INCHES		
°C	CENTIGRADE		
°F	FAHRENHEIT		
#	NUMBER		

Organizations and Documents

ORGANIZATION	ABBREVIATION
AMERICAN NATIONAL STANDARDS INSTITUTE	ANSI
AMERICAN SOCIETY OF TESTING AND MATERIALS	ASTM
AMERICAN WOOD PERSERVERS ASSOCIATION	AWPA
ASSOCIATION OF EDISON ILLUMINATING COMPANIES	AEIC
DEPARTMENT OF TRANSPORTATION	DOT
EDISON ELECTRIC INSTITUTE	EEI
ILLUMINATING ENGINEERING SOCIETY	IES
INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS	IEEE
INSULATED CABLE ENGINEERS ASSOCIATION	ICEA
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION	NEMA
NATIONAL FIRE PROTECTION ASSOCIATION	NFPA
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION	OSHA
UNDERWRITERS LABORATORY	UL
DOCUMENT	**ABBREVIATION**
ELECTRIC OPERATING PROCEDURE (PPL)	EOP
NATIONAL ELECTRICAL CODE	NEC
NATIONAL ELECTRICAL SAFETY CODE	NESC

DEFINITIONS

The following sources were used as a reference to define the following terms:

1. IEEE Standard Dictionary of Electrical & Electronic Terms – IEEE STD 100
2. The Lineman's and Cableman's Handbook
3. National Electrical Code
4. National Electrical Safety Code

A

AAC -	(All Aluminum Conductor) A conductor made wholly of 1350 alloy aluminum.
AAAC -	(All Aluminum Alloy Conductor) A conductor made wholly of 5005-H19 or 6201-T81 higher strength alloy aluminum.
ACSR -	(Aluminum Conductor Steel Reinforced) A composite conductor made up of a combination of aluminum and steel wires. In the usual construction the aluminum wires surround the steel wires.
ACTUAL SPAN -	The horizontal distance between two adjacent structures. The distance can be either to the structure ahead, Actual Span ahead, or to the back structure, Actual Span back. The Actual Span affects sags and clearances from the conductors to the ground.
ALIVE -	Electrically connected to a source of potential difference, or electrically charged so as to have a potential difference from that of the ground. **Note:** The term "alive" is sometimes used in place of the term "current-carrying", where the intent is clear, to avoid repetitions of the longer term. (IEEE-100)
AMPACITY -	The current-carrying capacity, expressed in amperes, of an electrical conductor under stated thermal conditions. (Per NESC)
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 terms "stub", "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. (IEEE-100)
ANCHOR GUY MARKER -	A protective cover over the guy, often a length of plastic or metal shaped to a semicircular or tubular section and equipped with a means of attachment to the guy. (IEEE-100)
ANODE -	An electrode through which current enters any conductor of the nonmetallic class. (IEEE-100)
ARRESTER -	See Surge Arrester
AWG -	(American Wire Gauge) The standard system used for designating wire diameter, also referred to as the Brown and Sharpe wire gauge. This system is based on a direct correlation between gauge number, cross section, weight, and the DC resistance of conductors.

B

BAY-O-NET FUSE - A pad mount transformer fuse, used to protect the line-side system from damage caused by transformer faults. Provides transformer protection from overloading and secondary fault current.

BIL - (Basic Lightning Impulse Insulation Level) A specific insulation level expressed in kilovolts of the crest value of a standard lightning impulse. (IEEE-100)

BOLLARD - A series of short posts set at intervals to delimit an area (as a traffic island) or to exclude vehicles

BONDING - The permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to conduct safely any current likely to be imposed. (IEEE-100)

The electrical interconnecting of conductive parts, designed to maintain a common electrical potential. (NESC)

BOOST - Raise or attempt to raise voltage.

BUCK - Lower or attempt to lower voltage.

BUCKARM - A crossarm placed approximately at right angles to the line crossarm and used for supporting branch or lateral conductors or turning large angles in line conductors. (IEEE-100)

BUSHING PLUG - An interface for a transformer/switch that allows cable to be attached with an elbow connector.

C

CABLE - A conductor with insulation, or a stranded conductor with or without insulation and other coverings (single-conductor cable), or a combination of conductors insulated from one another (multiple-conductor cable). (OSHA, NESC, IEEE-100)

CABLE JACKET - A protective covering over the insulation, core, or sheath of a cable. (IEEE-100)

CABLE RACK - A device usually secured to the wall of a manhole, cable raceway, or building to provide support for cables. (IEEE-100)

CABLE SHEATH - A conductive protective covering applied to cables. **Note**: A cable sheath may consist of multiple layers, of which one or more is conductive. (IEEE-100)

CATHODE - An electrode through which current leaves any conductor of the nonmetallic class. (IEEE-100)

CATHODIC PROTECTION - Reduction or prevention of corrosion by making a metal, the cathode in a conducting medium by means of a direct electric current. (IEEE-100)

CIRCULAR MIL - A unit of area equal to π/4 of a square mil (= 0.7854 square mil). The cross-sectional area of a circle in circular mils is therefore equal to the square of its diameter in mils. A circular inch is equal to one million circular mils. **Note**: One mil equals 0.0001 inches. There are 1974 circular mils in a square millimeter. (IEEE-100)

CLEARANCE -	The clear distance between two objects measured surface to surface.(OSHA, NESC)
CONDUCTOR -	A material, usually in the form of a wire, cable, or bus bar, suitable for carrying an electric current. (OSHA)
CONDUCTOR INSULATIONS -	BR Butyl rubber EPR Ethylene propylene rubber XLPE Cross-linked polyethylene TRXLPE Tree-retardant polyethylene PILC Paper Insulated, lead covered VC Varnish Cambric
CONDUCTOR, - BARE	One having no covering or insulation whatsoever. (IEEE-100)
CONDUCTOR COMPACT -	A round stranded conductor having all layers stranded in the same direction and successively passed through forming dies that forms the round conductor strands into a diamond-like shape. This results in a smoother, more nearly circular outer surface and effectively eliminates the void between individual wire strands.
CONDUCTOR COMPRESSED -	A concentric stranded conductor which, after completion of the stranding operation, is passed through forming dies that compress the strands of the outer layer into a diamond-like shape. This results in a smoother, more nearly circular outer surface, and reduces the void between individual strands in the outer layer.
CONDUCTOR CONCENTRIC -	A single straight core wire strand surrounded by one or more layers of helically wound wires in a fixed round geometric arrangement. Each layer after the first has six more strands than the preceding layer and is applied in a direction opposite to that of the layer under it.
CONDUCTOR COVERED -	A conductor covered with a dielectric having no rated insulating strength or having a rated insulating strength less than the voltage of the circuit in which the conductor is used.
CONDUCTOR INSULATED -	A conductor covered with a dielectric (other than air) having a rated insulated strength greater than or equal to the voltage of the circuit in which it is used. (NESC)
CONDUIT SYSTEM -	Any combination of duct, conduit, conduits, manholes, handholes and/or vaults joined to form an integrated whole. (IEEE-100)
CONNECTOR -	A coupling device employed to connect conductors of one circuit or transmission element with those of another circuit or transmission element. (IEEE-100)
CONTINUOUS LOAD -	A load where the maximum current is expected to continue for three (3) hours or more.
CORE LOSS, TRANSFORMER -	The measured power loss, expressed in watts, attributable to the material in the core and associated clamping structure of a transformer that is excited, with no connected load, at a core flux density and frequency equal to that in the core when rated voltage and frequency is applied and rated load current is supplied. (IEEE-100)
CURRENT CARRYING PART -	A conducting part intended to be connected in an electric circuit to a source of voltage. **Note:** Non-current carrying parts are those not intended to be so connected. (OSHA)

CURRENT LIMITING FUSE -	A fuse that, when it is melted by a current within its specified current-limiting range, abruptly introduces a high arc voltage to reduce the current magnitude and duration. **Note:** The values specified in standards for the threshold ration, peak let-through current, and I^2t characteristic are used as the measures of current-limiting ability. (IEEE-100)
CURRENT LIMITING FUSE CARRYING -	A pad mount transformer fuse that limits the potential for catastrophic failure of the transformer, due to internal faults.
CUTOUT -	An assembly of a fuse support with either a fuse holder, fuse carrier, or disconnect blade. When a fuse holder or fuse carrier is used, this device is used to automatically interrupt the flow of current through any particular apparatus or instrument. (IEEE-100)

D

DEAD -	Isolated, tagged, tested de-energized and grounded. (Safety Manual)
DEAD-FRONT (TRANSFORMERS & SWITCHGEAR) –	Without live parts exposed to a person on the operating side of the equipment. (IEEE-100)
DEADEND GUY -	An installation of line or anchor guys to hold the pole at the end of a line. (IEEE-100)
DE-ENERGIZED -	The absence of normal operating voltages associated with the operation of the system or control circuits. (Safety Manual) Disconnected from all sources of electrical supply by open switches, disconnectors, jumpers, taps, or other means. **Note:** De-energized conductors or equipment could be electrically charged or energized through various means, such as induction from energized circuits, portable generators, lightning, etc. (NESC)
DEMAND -	The load integrated over a specific interval of time. (IEEE-100)
DISCONNECT -	A device having a disconnecting blade for use as a disconnecting or isolating switch. (IEEE-100)
DUCT -	A single enclosed raceway for conductors or cables. (NESC)
DUCT BANK -	An arrangement of conduit providing one or more continuous ducts between two points. (IEEE-100)
DUCT SEALING -	The closing of the duct entrance for the purpose of excluding water, gas, or other undesirable substances. (IEEE-100)
DUPLEX CABLE -	A cable composed of two (2) insulated single conductors or one (1) insulated conductor and one (1) bare neutral conductor twisted together. (IEEE-100)

DUTY - Continuous Duty – Operation at a substantially constant load for an indefinitely long time.

Intermittent Duty – Operation for alternate intervals of:
1) load and no load; or
2) load and rest; or
3) load, no load, and rest.

Periodic Duty - Intermittent operation in which the load conditions are regularly recurrent.

E

EFFECTIVELY GROUNDED - Intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to limit the buildup of voltages to levels below that which may result in undue hazard to persons or to connected equipment. (NESC)

An alternating-current system or portion thereof may be said to be effectively grounded when, for all points on the system or specified portion thereof, the ratio of zero-sequence reactance to the positive-sequence reactance is less than three and the ratio of zero-sequence resistance to positive-sequence reactance is less than one for any condition of operation and for any amount of connected generator capacity. (IEEE-100)

ELBOW - A cable to apparatus connector.

ENCLOSED - Surrounded by case, cage, or fence designed to protect the contained equipment and limit the likelihood, under normal conditions, of dangerous approach or accidental contact by persons or objects. (NESC)

EXTRA-HIGH VOLTAGE SYSTEM - See Voltage Systems

F

FAULT CURRENT - A current that flows from one conductor to ground or to another conductor owing to an abnormal connection (including an arc) between the two. **Note:** A fault current flowing to ground may be called a ground fault current. (IEEE-100)

FEEDER - A set of conductors originating at a main distribution center and supplying one or more secondary distribution centers, one or more branch-circuit distribution centers, or any combination of these two (2) types of equipment. (IEEE-100)

FEED-THRU - A device to electrically connect elbows or other accessories.

FUSE - An overcurrent protective device with a circuit-opening fusible part that is heated and severed by the passage of overcurrent through it. (IEEE-100)

G

GROUND - A conducting connection, whether intentional or accidental, by which an electric circuit or equipment is connected to the earth or to some conducting body of relatively large extent that serves in place of the earth. (IEEE-100)

GROUND CURRENT - Current flowing in the earth or in a grounding connection. (IEEE-100)

GROUND GRID - A system of grounding electrodes consisting of interconnected bare cables buried in the earth to provide a common ground for electrical devices and metallic structures. (IEEE-100)

GROUND MAT - A system of bare conductors, on or below the surface of the Earth, connected to a ground or a ground grid to provide protection from dangerous voltages. (IEEE-100)

GROUND ROD - A rod that is driven into the ground to serve as a ground terminal, such as a copper-clad rod, solid copper rod, or galvanized iron pipe or rod. (IEEE-100)

GROUNDING TRANSFORMER - A transformer intended primarily to provide a neutral point for grounding purposes. **Note:** It may be provided with a Delta winding in which resistors or reactors are connected. (IEEE-100)

GUARDED - Covered, fenced, enclosed, or otherwise protected, by means of suitable covers or casings, barrier rails or screens, mats or platforms, designed to limit the likelihood, under normal conditions, of dangerous approach or accidental contact by persons or objects. **Note:** Wires that are insulated but not otherwise protected are not normally considered to be guarded. See exceptions under applicable rules. (NESC)

GUY - A tension member having one end secured to a fixed object and the other end attached to a pole, crossarm, or other structural part that it supports. (IEEE-100)

H

HANDHOLE - An access opening, provided in equipment or in a below-the-surface enclosure in connection with underground lines, into which personnel reach but do not enter, for the purpose of installing, operating, or maintaining equipment or cable or both. (NESC)

HIGH VOLTAGE SYSTEM - See Voltage Systems.

I

IMPEDANCE VOLTAGE (TRANSFORMER) - The voltage required to circulate rated current through one of two specified windings of a transformer when the other winding is short-circuited, with the windings connected as for rated voltage operation. **Note:** It is usually expressed in per unit or percent, of the rated voltage of the winding in which the voltage is measured. (IEEE-100)

INRUSH CURRENT (TRANSFORMER) - The maximum root-mean-square or average current value, determined for a specific interval, resulting from the excitation of the transformer with no connected load, and with essentially zero-source impedance, and using the minimum primary turns tap available and its rated voltage. (IEEE-100)

INSULATING CAP- A cap that is used for insulating, shielding and sealing a bushing plug.

INSULATION- That which is relied upon to insulate the conductor from other conductors or conducting parts or from ground (as applied to cable). (NESC)

INSULATOR - Insulating material in a form designed to support a conductor physically and electrically separate from another conductor or object. (IEEE-100)

ISOLATED NEUTRAL SYSTEM - A system that has no intentional connection to ground except through indicating, measuring, or protective devices of very high impedance. (IEEE-100)

J

JACKET -	A protective covering over the insulation, core, or sheath of a cable. (NESC)

L

LATERAL CONDUCTOR -	A wire or cable extending in a general horizontal direction at an angle to the general direction of the line conductor. (IEEE-100)	
LAY (CABLE) -	The helical arrangement formed by twisting together the individual elements of a cable. (IEEE-100)	
LIGHTNING ARRESTER -	See Surge Arrester.	
LIVE -	See Alive.	
LIVE FRONT (TRANSFORMERS & SWITCHGEAR) -	With live parts exposed to a person on the operating side of the equipment.	
LOAD FACTOR -	The ratio of the average load over a designated period of time to the peak load occurring in that period. (IEEE-100)	
LOAD LOSSES (TRANSFORMER) -	Those losses which are incident to the carrying of a specified load. Load losses include I^2R loss in the winding due to load and eddy currents, stray loss due to leakage fluxes in the windings, core clamps, and other parts; and the loss due to circulating current (if any) in parallel windings, or in parallel winding strands. (IEEE-100)	
LOCATION -	Damp Location –	Partially protected locations under canopies, marquees, roofed open porches, and like locations; and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold-storage warehouses.
	Dry Location –	A location not normally subject to dampness or wetness. Any location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction.
	Wet Location –	Installations underground or in concrete slabs or masonry in direct contact with the earth, and locations subject to saturation with water or other liquids such as vehicle washing area, and locations exposed to weather and unprotected.
LOSS FACTOR -	The ratio of the average power loss to the peak-load loss during a specified period of time. (IEEE-100)	
LOW VOLTAGE -	See Voltage Systems.	
LUG -	A wire connector device to which the electrical conductor is attached by mechanical pressure or solder. (IEEE-100)	
LUMINAIRE -	A complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply. (IEEE-100)	

M

MANDREL -	A tapered or cylindrical axle used to pull through conduit for inspections.
MANHOLE -	A subsurface enclosure that personnel may enter and is used for the purpose of installing, operating, and maintaining submersible equipment and cable. (NESC)
MANUAL -	Operated by mechanical force, applied directly by personal intervention. (IEEE-100)
MANUAL OPERATION -	Operated by hand without using any other source of power. (IEEE-100)
MEDIUM VOLTAGE SYSTEM -	See Voltage System.
MULTI- GROUNDED NEUTRAL SYSTEM -	A distribution system of the 4 wire type where all transformer neutrals are grounded, and neutral conductors are directly grounded at frequent points along the circuit. (IEEE-100, NESC) A system of conductors in which a neutral conductor is intentionally grounded solidly at specified intervals. A multigrounded or multiple grounded systems may or may not be effectively grounded. (NESC)

N

NAMEPLATE -	A plaque giving the manufacturer’s name and the rating of the equipment to which it is attached. (IEEE-100)
NETWORK -	An aggregation of interconnected conductors consisting of feeders, mains, and services. (IEEE-100)
NEUTRAL CONDUCTOR -	The conductor that is intended to be so energized, that, in the normal steady state, the voltages from every other conductor to the neutral conductor, at the terminals of entry of the circuit into a delimited region, are definitely related and usually equal in amplitude. (IEEE-100, NESC) A system conductor other than a phase conductor that provides a return path for current to the source. Not all systems have a neutral conductor. An example is an ungrounded delta system containing only three energized phase conductors. (NESC)
NO-LOAD LOSSES -	Those losses which are incident to the excitation of the transformer. No-load (excitation) losses include core loss, dielectric loss, conductor loss in the winding due to exciting current, and conductor loss due to circulating current in parallel windings. These losses change with the excitation voltage. (IEEE-100)
NOMINAL SYSTM VOLTAGE -	See Voltage, Nominal.
NON-EFFECTIVELY GROUNDED -	An alternating-current system or portion thereof may be said to be non effectively grounded when, for all points on the system or specified portion thereof, the ratio of zero-sequence reactance to the positive-sequence reactance is greater than three and the ratio of zero-sequence resistance to positive-sequence reactance is greater than one for any condition of operation and for any amount of connected generator capacity.

NOT EFFECTIVELY GROUNDED -	Not permanently connected to earth through a ground connection or connections of sufficiently high impedance and not having sufficient current-carrying capacity to prevent the building up of voltages that may result in undue hazard to connected equipment or to persons.
NOVOID X -	Filling compound for G & W porcelain potheads and armored cable joint boxes.

O

OFC -	Oil Fused Cutout.
OPEN WIRE -	Single conductor, bare, covered or insulated, and separated by air from other conductors, e.g, not a cable.

P

PAD-MOUNTED -	A general term describing equipment positioned on a surface-mounted pad located outdoors. **Note**: The equipment is usually enclosed with all exposed surfaces at ground potential. (IEEE-100)
PAD-MOUNTED TRANSFORMER -	A transformer utilized as part of an underground distribution system, with enclosed compartment(s) for high voltage and low voltage cables entering from below and mounted on a foundation pad. (IEEE-100)
PARKING STAND -	A bracket designed for installation on an apparatus, suitable for holding accessory devices, such as insulated parking bushing and grounding bushing. (IEEE-100)
PILC-	Paper Insulated Lead Covered Cable
POLE-TYPE TRANSFORMER -	A transformer that is suitable for mounting on a pole or similar structure. (IEEE-100)
POTHEAD -	A device that seals the end of a cable and provides an insulated exit for the conductor or conductors. (IEEE-100)
POWER FUSE -	A fuse consisting of an assembly of a fuse support and a fuse unit or fuseholder that may or may not include the refill unit or fuse link. **Note:** The power fuse is identified by the following characteristics: (1) Dielectric withstand (basic impulse insulation level) strengths at power levels; (2) Application primarily in stations and substations; (3) mechanical construction basically adapted to station and substation mounting. (IEEE-100)
PRESSURE RELIEF DEVICE -	A means for relieving internal pressure in a transformer, possibly preventing explosive shattering of the tank or tank cover, following prolonged passage of fault current due to external faults or internal transformer faults. (IEEE-100)
PULLING EYE -	A device that may be fastened to the conductor or conductors of a cable or formed by or fastened to the wire armor and to which a rope may be directly attached in order to pull the cable into or from a duct. (IEEE-100)
PUSH BRACE -	A supporting member, usually of timber placed between a pole or other structural part of a line and the ground or a fixed object. (IEEE-100)

Q

QUADRUPLEX CABLE - A cable composed of four (4) insulated single conductors or three (3) insulated conductors and one (1) bare neutral conductor twisted together.

R

RADIAL SYSTEM - A system in which independent feeders branch out radially from a common source of supply. (IEEE-100)

RISER POLE - Pole on which overhead wires connect to underground cable.

RULING SPAN - A calculated deadend span length, which will have the same changes in conductor tension due to changes of temperature and conductor loading, as will be found in a series of spans of varying lengths between deadends. (IEEE-100)

S

SAG - The distance measured vertically from a conductor to a straight line joining its two (2) points of support. Unless otherwise stated, the sag referred to is the sag at the midpoint of the span. (IEEE-100)

SECONDARIES - Circuits 600 volts and below.

SEPARATION - The distance between two objects, measured surface to surface, and usually filled with a solid or liquid material. (NESC)

SERVICE DROP - The overhead conductors between the electric supply or communication line and the building or structure being served. (NESC)

SERVICE ENTRANCE CONDUCTORS, OVERHEAD SYSTEM – The service conductors between the terminals of the service equipment and point usually outside the building, clear of building walls, where jointed by tap or splice to the service drop. (NEC)

SERVICE ENTRANCE CONDUCTORS UNDERGROUND SYSTEM - The service conductors between the terminals of the service equipment and the point of connection to the service lateral. **Note:** Where service equipment is located outside the building walls there may be no service-entrance conductors, or they may be entirely outside the building. (NEC)

SERVICE LATERAL - The underground service conductors between the street main, including any risers at a pole or other structure or from transformers, and the first point of connection to the service-entrance conductors in a terminal box, meter, or other enclosure with adequate space, inside or outside the building wall. Where there is no terminal box, meter, or other enclosure with adequate space, the point of connection shall be considered to be the point of entrance of the service conductors into the building. (NEC)

SIDE BREAK SWITCH - A switch in which the travel of the blade is in a plane parallel to the base of the switch. (IEEE-100)

SIDEWALL PRESSURE - The crushing force exerted on a cable during installation. (IEEE-100, NESC)

SOLIDLY - GROUNDED	Grounded through all adequate ground connection in which no impedance has been inserted intentionally. **Note:** Adequate as used herein means suitable for the purpose intended. (IEEE-100)
SPACER CABLE -	A type of electric supply-line construction consisting of an assembly of one or more covered conductors, separated from each other and supported from a messenger by insulating spacers. (IEEE-100, NESC)
SPAN LENGTH -	The horizontal distance of two (2) adjacent supporting points of a conductor. (IEEE-100)
SPLICE -	A physical connection of two (2) or more conductors to provide electrical continuity. (IEEE-100)
SPLICE TYPES-	Double Wye: also known as a double double or an H splice, splices four cables together.
	Modula/Separable: A joint that is built that can be easily taken apart by mechanical means.
	Normal: A splice of two similar cables.
	Reducing: A type of splice that will join two different sizes of cable together.
	Reducing/Transition: To splice a PILC cable to a smaller solid dielectric cable.
	Transition: Splicing together PILC cable to solid dielectric cable.
	Trifurcating: Splicing a 1-3/C cable to a 3-1/C cable.
	Trifurcating/Transition: Splicing a 1- 3/C PILC cable to 3-1/C solid dielectric cable.
	Wye: Splicing 3 cables together.
STEP-DOWN TRANSFORMER -	A transformer in which the energy transfer is from a higher voltage circuit to a lower voltage circuit. (IEEE-100)
STEP-UP TRANSFORMER -	A transformer in which the energy transfer is from a lower voltage circuit to a higher voltage circuit. (IEEE-100)
SUBMARINE CABLE -	A cable designed for service under water. **Note:** Submarine cable is usually a lead-covered cable with a steel armor applied between layers of jute. (IEEE-100)
SUBMERSIBLE TRANSFORMER -	A transformer so constructed as to be successfully operable when submerged in water under predetermined conditions of pressure and time. (IEEE-100)
SUBWAY TRANSFORMER -	A submersible-type distribution transformer suitable for installation in an underground vault. (IEEE-100)
SURGE ARRESTER -	A protective device for limiting surge voltage on equipment by discharging or bypassing surge current; it prevents continued flow of follow current to ground, and is capable of repeating these functions as specified. (IEEE-100)
SWEEP -	A manufactured bend installed at pad mounted equipment locations.

SWITCH -	Disconnecting or Isolation Switch -	A mechanical switching device used for changing the connections in a circuit or equipment from the source of power. **Note:** It is required to carry normal load current continuously, and also abnormal or short-circuit currents for short intervals as specified. It is required to open or close circuits either when negligible current is broken or made, or when no significant change in the voltage across the terminals of each of the switch poles occurs.
	Load-Interrupter Switch -	A disconnecting or isolating switch equipped with an interrupter and designed to interrupt currents not in excess of the continuous-current rating of the switch.
	Regulator Bypass Switch -	A specific device or combination of devices designed to bypass a regulator.

T

TERMINAL - A conducting element of equipment or a circuit intended for connection to an external conductor. (IEEE-100)

TERMINAL CONNECTOR - A connector used for attaching a conductor to a lead, terminal block, or stud of electric apparatus. (IEEE-100)

TERMINAL PAD - A usually flat conducting part of a device to which a terminal connector is fastened. (IEEE-100)

TERMINATOR - An insulator used to protect each cable conductor passing through the device and provide complete external leakage insulation between the cable conductor(s) and ground.

TERMINATOR /POTHEAD - A device that seals the end of a cable and provides insulated egress for the conductor or conductors. (IEEE-100)

TIE LINE - A transmission/distribution line connecting two (2) or more power systems. (IEEE-100)

TOTAL LOSSES - The sum of the no-load and load losses, excluding losses due to accessories. (IEEE-100)

TRIPLEX CABLE - A cable composed of three (3) insulated single conductors or two (2) insulated single conductors and a bare neutral conductor twisted together. (IEEE-100)

U

ULTRA HIGH VOLTAGE SYSTEM - See Voltage System

UNGROUNDED - A system, circuit, or apparatus without an intentional connection to ground except through potential indicating or measuring devices or other very high impedance devices. (IEEE-100)

UNIGROUNDED NEUTRAL SYSTEM - A system of conductors in which one conductor is intentionally grounded solidly at a specific location, typically at the source.

V

VAULT -	A structurally sound enclosure, including all side, top, and bottom, above or below ground where entry is limited to personnel qualified to install, maintain, operate, or inspect the equipment or cable enclosed. The enclosure may have openings for ventilation, personnel access, cable entrance, and other openings required for operation of equipment in the vault. (NESC)	
VOLTAGE, - NOMINAL	A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (as 120/240, 480Y/277, 600, etc.). The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment. See “Electric Power Systems and Equipment – Voltage Ratings (60 Hz)” (ANSI C84.1-82, IEEE-100)	
VOLTAGE - SYSTEMS	Low-Voltage System -	An electric system having a maximum root-mean-square alternating-current voltage of 1000 volts or less. (IEEE-100)
	Medium Voltage System -	An electric system having a maximum root-mean-square alternating-current voltage above 1000 volts to 72,500 volts. (IEEE-100)
	High Voltage System -	An electric system having a maximum root-mean-square alternating current voltage above 72,500 volts to 240,000 volts. (IEEE-100)
	Extra-High Voltage System -	An electric system having a maximum root-mean-square alternating current voltage above 240,000 volts to 800,000 volts. (IEEE-100)
	Ultra-High Voltage System -	An electric system having a maximum root-mean-square alternating current voltage above 800,000 volts to 2,000,000 volts. (IEEE-100)
VOLTAGE TO - GROUND	For grounded circuits, the voltage between the given conductor and that point or conductor of the circuit that is grounded. For ungrounded circuits, the greatest voltage between the given conductor and any other conductor of the circuit. (IEEE-100)	

W

WEIGHT SPAN -	Distance to the low point in the Actual Span ahead + distance to the low point in the Actual Span back. The weight span is a calculated term used to determine the vertical loading in crossarms and poles from the weight of ice coated conductors.
WIND SPAN -	½ Actual Span ahead + ½ Actual Span back. The wind span is a calculated term used to determine the transverse loading on the pole from the wind on ice coated conductors.
WOUND -	Single Wound – One cable wound on a reel. Triple Wound – Three cables in parallel wound on a reel.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
2.4	7/20	• Added sub-transmission voltage section • Reformed section numbering • Removed NH references in distribution voltages. • Removed 25 Hertz feeder references.		
2.3	7/18	• Corrected note 2 in 1.3.10 • New Section 1.6 Compliance • Updated Copyright		
2.2	7/17	• Corrected title in 1.3.20		
2	7/15	• Added new section 1.0 and 1.1. • Renumbered later sections and pages. • Added document control notices at tops of pages.		
1/1	7/12	• Added additional abbreviations		

Superceded 7/17 Issue- Update 2.3

Supersedes 7/20 Issue – Updated index to reflect changes in document

2.0 GENERAL

This Section covers the selection and installation of distribution poles and hardware for use on the overhead distribution systems. To ensure that the structural integrity is economically maintained for the expected life of the equipment, all wood products are treated with an acceptable preservative. Currently, pentachlorophenol (penta) preservative is purchased. The use of such equipment is most critical for maintaining a safe, reliable, and efficient overhead distribution system.

2.1 POLE SPECIFICATION AND IDENTIFICATION

Distribution poles shall be solid wood, fiberglass (fiber-reinforced polymer), or metal and in accordance with applicable standards such as ANSI Standard O5.1, Company MS2005, and MS2010. In general, poles listed on Page 2-101 are used for distribution circuits. However, where taller poles are required or pole loading is such that larger poles are required, poles traditionally stocked for transmission or sub-transmission structures may be used. Distribution pole strengths are designated by "class" 1 through 6. These classes establish pole circumference minimums Transmission Class H1 poles are utilized for critical structures as part of our storm hardening efforts (refer to Section 4 – Storm Hardening).

2.1.10 Pole Numbering

Each pole carrying Company attachments shall be Company identified and individually numbered on the road-side face of the pole, approximately 7 feet above grade, as shown on Drawing 2-111. On privately owned poles, which have Company equipment attached, a single letter "P" shall be installed below the pole number. Main junction and equipment support poles may also be identified by having the line number placed above the pole number.

Each individual pole line (8 or more poles) shall have poles consecutively numbered beginning at its origination from the main line. Short branch lines expected to never contain more than eight poles shall be sub-numbered from the tap pole.

2.1.20 Reflectors

All states within the PPL service territory do not have a reflector requirement, but reflectors may be used where deemed appropriate.

Reflective Color – On ramps, freeways, divided highways, and one-way streets, reflective material shall face oncoming traffic and shall be colored white on the right side of the roadway and yellow on the left side of the roadway. On two-way undivided roadways, reflective material shall be colored white and shall be placed on poles to the right of, and facing, oncoming traffic on each side of the road.

2.1.30 Phase and Feeder Numbering

Phase and feeder identification shall be installed on the first pole outside of the substation and when requested.

Phase identification shall be installed and located per construction drawings (2-112, 2-112A) on all smart technology devices as follows:

a. 3Φ reclosers 3Φ advanced capacitors, 3Φ voltage regulators, and 3Φ feeder monitors.

Prior to any work on multi-phase lines, phase identification shall always be confirmed with proper testing equipment (e.g. phase tester). Absolute phase relationship can be best identified using Company approved long distance phasing tools.

Supersedes 7/19 Issue – Revised 2.1.30 Phase and Feeder Numbering.

2.2 POLE LENGTH

The pole length and the available Company space on the pole shall be selected so that there is adequate clearance for all Company conductors and equipment that may reasonably be needed in the future. Space should be provided for communication circuits only if the communication company has arranged for joint ownership of the pole. Refer to Section 17 - Joint Use - for more information on pole ownership.

The conductor profile should also be considered in selecting pole length. If poles are set less than 150 feet apart, a difference of more than 5 feet in elevation should be avoided. For longer spans, this difference may be increased proportionately. If it is not possible to stay within these limits, it may be necessary to check the stringing and final tensions and to deadend conductors to avoid uplift or excessively heavy downward loads.

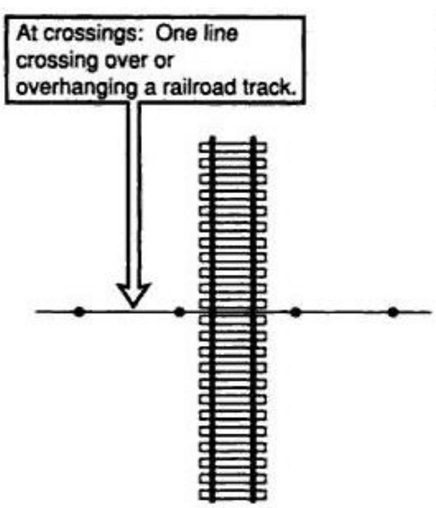
2.3 POLE STRENGTH

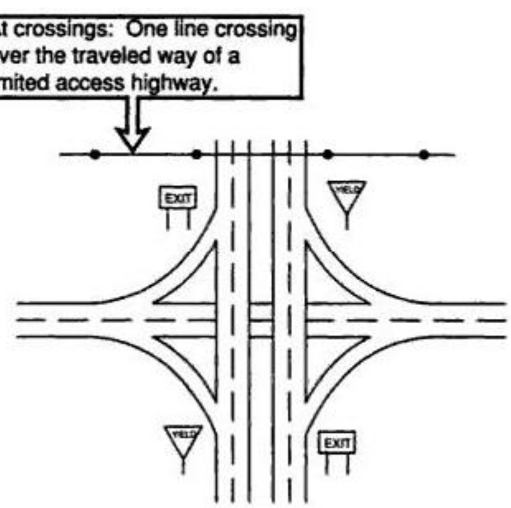
2.3.10 National Electric Safety Code Construction Grades and Overload Factors

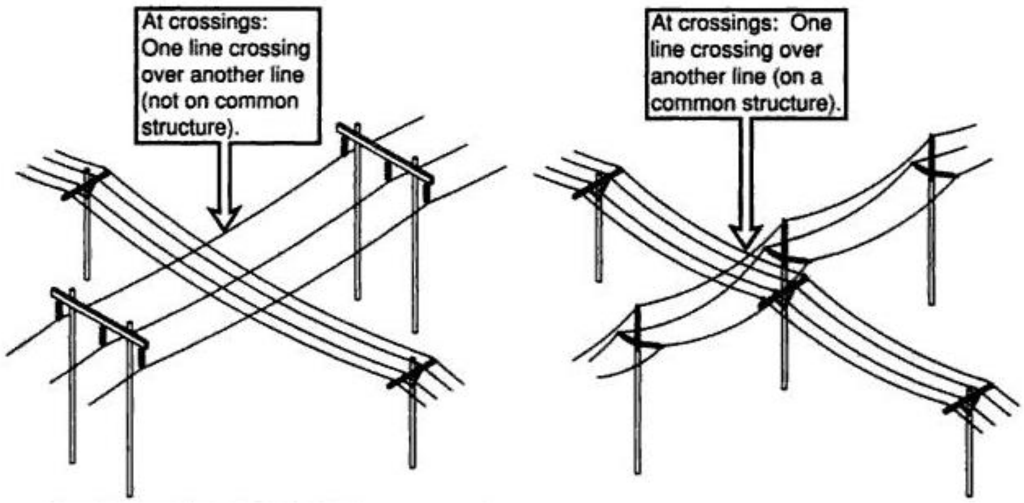
The National Electrical Safety Code (NESC) specifies grades of construction which satisfy required strength for safety. The relative order of grades for supply and communication conductors and supporting structures is B, C, and N, with Grade B being the highest strength. PPL structures are typically built to Grade C except where Grade B is required per the NESC or other PPL requirements. Grade N is not used. Increases in strength are accomplished by the use of overload factors and strength factors. For example, when designing a line to support transverse wind loads the calculated value must be multiplied by 2.5 to satisfy Grade B. The same design would be multiplied by 1.75 to satisfy Grade C. See Tables 1 and 2 for applicable overload and strength factors. Additionally, see Section 2.10.10 Examples 1, 2 and 3.

Repaging

Grade B construction is primarily required at crossings. Refer to the following figures for where Grade B is required. For crossings where one line crosses over another, Grade B is required for the top line only. The bottom line need only have the grade of construction that would be required if the line at the higher level were not there.

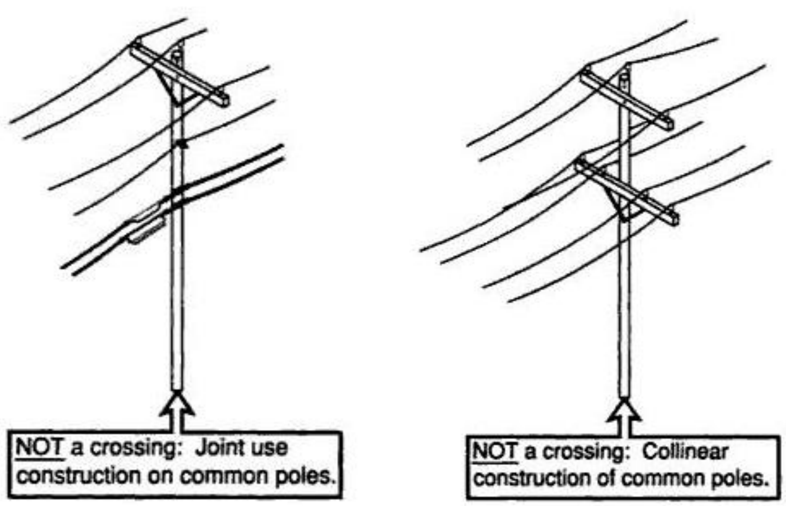






Supersedes 7/11 Issue – Text and figures shift on page.

The following two figures are examples where Grade B construction is **not** required:



Breaking strengths of poles are shown on Page 2-101. The appropriate NESC overload factors and strength factors for structures and supported facilities not exceeding 60 feet above ground or water level are shown in Table 1 and Table 2. In the application of overload factors and strength factors, the objective is to design a structure with resistance greater than the maximum load expected during the lifetime of the structure and to design the structure with an acceptable level of safety and reliability. Final design loading is calculated by multiplying the transverse, vertical, and longitudinal forces by these overload factors and by installing appropriate guying per the requirements in Section 3. Spacing of holes shall be drilled on centers at least 4 inches apart when drilled on the same plane and holes located on opposing planes shall be drilled on centers at least four hole diameters apart. NOTE: On joint owned poles, the joint pole owner should be consulted for minimum spacing requirements relating to attachments located in the "communication space".

Table 1

Overload Factors			
	Grade B	Grade C	
		At crossings	Elsewhere
Vertical Loads	1.50	1.90**	1.90**
Transverse Loads			
Wind	2.50	2.20	1.75
Wire Tension	1.65	1.30*	1.30*
Longitudinal Loads			
In General	1.10	No requirement	No requirement
At Deadends	1.65	1.30*	1.30*

* For metal or prestressed concrete, portions of structures, crossarms, guys, foundations, and anchors, use a value of 1.10

** For metal, prestressed concrete, or fiber-reinforced polymer portions of structures and crossarms, guys, foundations, and anchors, use a value of 1.50

Table 2

Strength Factors		
	Grade B	Grade C
Wood Structures	0.65	0.85
Metal, Fiber-Reinforced Polymer Structures	1.0	1.0

2.3.20 Transverse Strength

Poles with heavy wire loading on lines should be checked for unbalanced load due to wind. See Section 6.1.10 for transverse wind calculations and Section 3 for guying calculations.

2.3.30 Deadend and Angle Strength

Poles at deadends and angles shall be guyed as specified in Section 3. If guys are not practical, the bearing of the soil rather than the pole strength is usually the critical value. In general, unbalanced loads at 60˚F shall not exceed 300 pounds. Slack spans should be used to limit unbalanced loading. Other options such as alternate poles (laminated wood, steel, etc) or concrete embedment can be considered. Contact Distribution Standards Engineering for assistance with pole selection or other options.

2.3.40 Vertical Strength

When transformers or other such equipment approaches their maximum size and there are other loads from down guys, change of grade, etc., heavier poles may be required. Heavy anchor guys should be avoided on these particular poles. Head guys or slack spans are recommended to keep the size of the anchor guy at a minimum.

Poles with heavy vertical loads may require additional support to prevent the pole from tipping or sinking into the ground. A footing and appropriate backfill such as #2 crushed stone is recommended where there is good reason to doubt the bearing of the soil. Particular weights can be determined through various standard or material specification sections or by checking nameplate information.

2.4 POLE SETTING

Any permits or rights-of-way required from authorities or property owners regarding pole location, digging, tree trimming, and/or conductor installation shall be obtained before proceeding with the work. The communication companies shall be notified and provision made for joint occupancy, if desired, before pole installation plans are issued.

For depth of setting into earth, rock, or wet soil, see Page 2-101. The general setting depth of a pole into earth is 10% of its total length plus two feet. The depth of holes on slopes shall be measured from the low or downhill side of the pole. For solid rock, granite, or basalt, blasting or rock drilling may not be practical, and poles may be installed in rock anchored mounts as shown on Drawing 2-105. Consult with Standards Engineering for poles that will be located in very wet or standing water areas, as they may require the use of multiple pole guys or foundation supports.

Every effort should be made to set poles so that the resulting line will be as straight, orderly, and inconspicuous as possible. The poles shall be vertical and in line with each other when the conductors have been installed. This requires care and judgment when raking poles against the pull and towards the uphill side on slopes, tamping backfill, and in using appropriate backfill such as #2 crushed stone when necessary. Increased setting depth should be considered where soil conditions may be unreliable. Poles that tip after installation should be straightened and thoroughly retamped, and/or appropriate backfill such as #2 crushed stone shall be used if necessary. The diameter of the hole shall be large enough to permit free entrance of the butt, and to permit tamping throughout the entire depth. Sides of the hole shall be straight.

Pole gains shall normally be faced away from deadends, long spans, or other construction. They shall be faced away from crossings (where one line crosses over or under another line). This arrangement is recommended even when construction does not require crossarms. Pole gains should alternate direction faced along the line. This improves the crossarm resistance to unbalanced longitudinal loads such as in the event of partial line failures.

2.4.10 Contaminated Sites

For sites with environmental conditions associated with the presence of subsurface oil or hazardous material contamination, establishment of a “Clean Corridor” for Company electric facilities would limit potential, present and future hazardous exposures to our field workers. Drawing 2-301 and Drawing 2-301A provide details concerning “Clean Corridor” installations. “Clean Corridors” may be established by PPL or by third parties (e.g., site developers). Coordinate with Environmental during project planning, as specified in procedures EG-301 – Project Planning and Permitting and EG-1709 – Projects on Sites with Environmental Encumbrances.

2.5 POLE LOCATION

Poles should be located where they can best serve both present and future customer requirements, where appearance is not objectionable to the community, where they are not likely to have to be moved in the near future, and where they are least likely to be struck by motor vehicles. Adequate conductor clearances, per Section 7, must be maintained. Poles shall not be set closer than 6 inches from the street side of a curb.

When staking out new lines or when rebuilding on streets with existing poles, the overall appearance of the line after completion should be considered. Existing poles should be used when practical, but installing more poles than necessary must be avoided. Frequent road crossings should also be avoided.

Poles and accompanying guys set in alleys, parking lots, and similar areas should be located to minimize vehicle damage. If necessary, arrange for guard rail installation, concrete bumpers, or other protection to minimize vehicle damage to poles and guys in these areas. Special attention shall be given to guard poles holding overhead primary equipment.

Pole line layout must include planning for future buildings or structures along the property lines or, if local ordinances specify, along the established building line. If it is likely that a new structure will be erected in the foreseeable future, the right-of-way should be adequate enough to provide required clearances for such structure.

Supersedes 7/14 Issue – Added Contaminated Site Section.

2.6 POLE ATTACHMENTS

No Company attachments to poles owned by others (foreign poles) shall be made until proper approval has been obtained from the pole's owner(s). Likewise, no attachments, temporary or permanent, to Company owned poles by any entity, including persons, companies, or government entities, other than those specifically approved in a written agreement with the entity, shall be made to Company poles without prior approval.

In addition, permanent pole steps shall not be utilized on wood distribution poles.

2.7 WOOD POLE SALVAGE

When a wood distribution pole that has been in service for less than ten years needs to be removed, one should consider reusing the pole if the following conditions are met.

1. The pole shall be at least a 35 foot, class 5 pole.
2. The pole shall be in sound condition. It shall be free from surface defects that would interfere with climbing. It shall also be free of surface rot, butt decay, ragged or decayed roof, and with no sign of longitudinal cracks or crossbreaks.
3. The pole shall also be of standard framing.

2.8 ALTERNATIVE POLES

Alternative poles including fiberglass and metal per appropriate material specifications can be purchased and installed resulting in a cost effective installation.

2.8.10. Fiberglass Poles

Lightweight easy to handle fiberglass poles can be selected for difficult locations including rights-of-ways, wetlands, and backyards. Unique environmental conditions including woodpecker attack may also warrant a fiberglass pole installation.

2.8.20. Metal Poles

Metal poles can be selected for installation locations when increase pole strength requirements are necessary due to heavy equipment loading, environmental loading, or where guying cannot be accomplished. Since these poles are designed specific, all specifications and moments shall be calculated and provided to supplier for appropriate fabrication. Metal pole installations will require additional insulation equipment such as fiberglass crossarms and brackets, insulators, and additional surge arresters to maintain appropriate lightning insulation values. In addition, metal poles shall not be installed in heavily corrosive environments which results in oxidation.

2.8.30. Attachments

Most standard, non-cleated line hardware can be used on alternative poles with conventional fasteners and installation practices. Structural attachments must be made with through bolts and square washers which enhances the load-bearing capacity interface. Fiberglass crossarms and fiberglass armless brackets shall be used. Fiberglass crossarms include centermounts for attaching and down grounds shall be installed using nylon clips with self tapping screws. Equipment and line attachment bolts may, when practical utilize the standard evenly spaced step bolt holes. Except for un-guyed installations, the same wood pole burial depth and backfill requirements exist.

2.8.40. Unguyed Poles

For installations where guying is not an option due to structures near the pole or other objects restricting guy wire placement, an unguyed fiberglass pole can be installed. Three pole sizes are available; 45/H4 (STD ID P77DH4), 50'/H5 (STD ID P77DH5) and a 55'/H6 (STD ID P77DH6).

Supersedes 7/20 – Updated 2.6.

Supersedes 1/06 Issue - Text shift.

2.9 POLE LINE HARDWARE

Pole line hardware will be of a type specifically developed for utility pole line installation in accordance with industry specifications.

2.9.10 Crossarms

Overhead distribution crossarms shall be solid wood or fiberglass and in accordance with applicable standards such as Company MS2121 and MS2142. Both wood and fiberglass crossarms can be installed on any type of pole (wood, fiberglass, steel, etc.), however, fiberglass arms are not designed to be used for alley-arm construction.

For installations above 2000 lbs. tension, Engineering shall make sure that the conductor tension under NESC heavy loading conditions obtained from Section 6 is less than the permissible deadend loading per conductor of the crossarm assembly. However, if the conductor tension is limited to 2000 lbs, the NESC allows the use of double wood crossarm or equivalent strength fiberglass assemblies for Grade B and C. In addition, the deadend span should be less than the maximum span length allowed due to vertical crossarm strength limitations. However, this is seldom a limiting factor in distribution design.

For Grade B construction, the NESC requires the use of double wood or equivalent strength fiberglass crossarms at each crossing structure, at deadends, and at corners where line angles exceed 20 degrees. Under similar conditions, where brackets are used to support conductors and there is no crossarm below, double brackets or a support assembly equivalent in strength to double wood crossarms shall be used (NESC 261D5c). Wires, conductors, or other cables of one line are considered to be at crossings when they cross over another line, whether or not on a common supporting structure, or when they cross over or overhang on a railroad track or the traveled way of a limited access highway or navigable waterways requiring waterway crossing permits. Joint-use or collinear construction in itself is not considered to be at crossings (refer to Section 2.3.10 above for more information).

2.9.20 Vertical Strength of Wood Crossarms

The NESC requires that the sum of each vertical load attached to a crossarm assembly, multiplied by the load's appropriate NESC vertical overload factor (Table 1), and the load's distance to the center of the crossarm assembly not exceed the permitted vertical moment capacity of the crossarm.

Vertical loads on the crossarm assembly per NESC include;
1. The weight of the conductors.
2. The weight of a 250 lb line worker.
3. The self-weight of the crossarm.
4. The weight of other hardware including cutouts.

Depending on this information, the maximum span length allowed for various conductors can be obtained by using the following formula:

∑Applied vertical load moments ≤ Permitted vertical moment capacity

$$\mathbf{((D_1 + D_2) \times S \times W \times F_V) + M_E \leq N \times M_V \times F_S}$$

S = Weight span length (ft.)
D_1, D_2 = distance of conductor from center of the crossarm (ft., see Figure 1)
N = number of crossarms
W = unit weight of conductor (lbs/ft.)
M_E = moment due to weight of equip. attached to crossarm (ft.-lbs.)

M_v = vertical moment capacity of the crossarm with predrilled holes
$M_v = F_b \times X_v$ (ft.-lbs.)
X_v = vertical section modulus of the crossarm (in.^{3})
$X_v = (bd^3 - ba^3 - ad^3)/6d$
b = width(in., top of arm), d = depth(in., face of arm)
a = diameter (in.) of crossarm mounting holes
F_b = the designated modulus of rupture for crossarms
(ANSI 05.1 → F_b = 8,000 lbs/in^2)
F_S = NESC strength factor
F_V = NESC vertical overload factor

2.9.30 Longitudinal Strength of Wood Crossarms

It may be assumed that longitudinal loads do not contribute to the vertical loading on crossarm assemblies. However applied vertical loads do have to be considered when determining the permitted longitudinal load of a crossarm assembly. Depending on this information, the following relationship needs to be satisfied to avoid overloading the wood fibers of crossarms:

$$\frac{\sum \text{Applied Vertical Load Moments}}{\text{Permitted Vertical Moment Capacity}} + \frac{\sum \text{Applied Longitudinal Load Moments}}{\text{Permitted Longitudinal Moment Capacity}} \leq 1$$

Applied vertical load moments and permitted vertical moment capacity were defined in 2.9.20 above. Applied longitudinal load moments and permitted longitudinal moment capacity for deadend crossarm assemblies are as follows:

$\sum$Applied longitudinal load moments = $(D_1 + D_2) \times L \times F_{OL}$
Permitted longitudinal moment capacity = $N \times M_h \times F_S$
L = permissible deadend loading per conductor (lbs.)
D_1, D_2 = distance of conductor from center of the crossarm (ft., see Figure 1)
N = number of crossarms
M_h = longitudinal moment capacity of the crossarm with predrilled holes
$M_h = F_b \times X_h$ (ft.-lbs.)
X_h = longitudinal section modulus of the crossarm (in.^{3})
$X_h = (db^3 - ab^3 - da^3)/6b$
b = width(in., top of arm), d = depth(in., face of arm)
a = diameter (in.) of crossarm mounting holes
F_b = the designated modulus of rupture for crossarms
(ANSI 05.1 → F_b = 8,000 lbs/in^2)
F_S = NESC strength factor
F_{OL} = NESC longitudinal overload factor

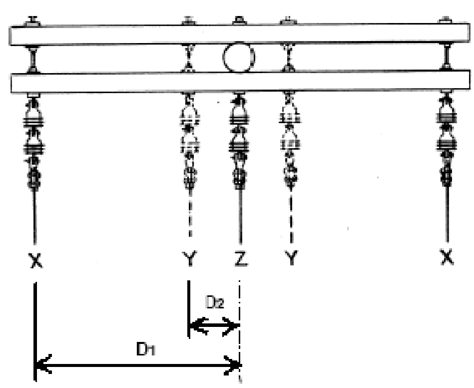


Figure 1

Supersedes 7/14 Issue - Text shift.

Supersedes 7/08 Issue - Text shift; ,minor editorial changes.

2.9.40 Crossarm Braces

The NESC requires all crossarms to be securely supported by bracing, if necessary, to support all loads including the weight of line workers. Wood crossarm braces shall be used for all standard construction installations increasing the pole top distribution insulation level.

2.9.50 Insulators

The operating performance of overhead distribution lines is dependent upon the quality of the line insulators. Line insulators can be porcelain or polymer. Polymer (HDPE) pin type insulators for distribution are available and shall be used with all new and existing covered conductors including tree wire, spacer cable, and older polyethylene covered conductor. HDPE insulators and conductor coverings are dielectrically compatible with neither one being electrically over-stressed. During insulator replacement, always examine existing conductor covering for erosion, cracks, or puncture holes. If significant damage exists, install a porcelain radio free insulator and skin the covering back at least 30 inches on each side.

A #4 solid, soft drawn, thermoplastic rubber (TPR) covered aluminum tie wire is available and is the only tie wire that shall be used with all HDPE insulators with unskinned, covered aluminum or unskinned, covered copper conductors. The TPR covering provides similar dielectric characteristics and a slip-proof grip on covered conductors.

HDPE insulators can be used on bare conductors in areas where vandalism occurs provided environmental contamination doesn't exist and conductor operating temperatures are below 100°C.

2.9.60 Pole Top Extension

Pole top extensions shall be installed only on sound wood poles. The wood pole top should be squared off to accept the adapter base bracket and to facilitate installation; the base component may be installed onto the pole first, before the wood or fiberglass extending member is attached.

Do not use pole top extensions (wood or fiberglass) at deadends or Grade B locations (e.g. crossings). Transverse loading shall be limited to 1600 lbs (applied 12 inches below top of extension) in compliance with NESC overload factors in Table 1.

2.9.70 Raptor Protection

One or more state and federal laws legally protect many species of birds in the Company's service territory. So that the Company complies with laws and regulations protecting these birds, it is necessary to follow appropriate procedures regarding raptor protection. A 60" separation between energized and/or grounded facilities is generally recognized. Since this is rarely encountered on distribution lines, covers can be installed to prevent simultaneous contact between energized and/or grounded facilities.

Any distribution pole with an active nest or confirmed nesting attempts should be reported to Environmental. The distribution pole may need to be modified per appropriate raptor construction drawings as determined appropriate in consultation with Environmental.

2.10 POLE CLASSIFICATION

Selecting the proper class pole is an important decision in distribution design. The pole class is mainly dependent upon the loading that the pole must withstand under NESC heavy loading conditions. Conductor loading, equipment loading, and downward forces caused by guying, must all be considered in order to select the proper class of pole.

This section will include methods of determining the class of an unguyed pole considering conductor loading and equipment loading only. See Section 3 for determining the class of a guyed pole.

2.10.10 Example 1

Given:

Determine the class of pole required to support the following wires and equipment on a 40 foot, unguyed wood pole with a 150 foot wind span for Grade C construction (non-crossing) under heavy loading conditions (4 lbs/sf wind, ½" radial ice). Assume a 3 degree line angle.

3-477kcmil Al AAC bare conductors - 33.5' attachment height
(Outside phases are the same horizontal distances from the pole, therefore no bending moment is created)
3/C-1/0 triplex secondary - 27.3' attachment height
0.750-1/4" messenger (CATV) - 24.0' attachment height
134-216 fiber optic and 1/4" messenger telephone cable - 23.0' attachment height
400 pair, #22 AWG and 3/8" messenger telephone cable - 22.0' attachment height
400 pair, #22 AWG and 3/8" messenger telephone cable - 21.0' attachment height
400 pair, #22 AWG and 3/8" messenger telephone cable - 20.0' attachment height
1-50 kVA single-phase transformer - 29.5' attachment height
- 16" from the center of transformer to the center of pole

Step	Action	Use
1	Check the pole strength due to the transformer vertical load: The weight of the transformer is 750 lbs. Check the allowable weight that can be mounted from 4.5 feet (54 inches) from the top of the pole by using Table 3. Try Class 5 first.	Transformer weight = 750 lbs Allowable weight = **2085 lbs** Class 5 is adequate for vertical load. (This case will most likely not govern since vertical load typically do not govern for unguyed poles.)
2	Calculate the groundline moment due to the conductor wind load.	Moment = $F_w \times S_w \times W_w \times H$ F_w = NESC overload factor for wind load (See Section 2, Table 1.) S_w = wind span length (ft) W_w = transverse conductor loading (lbs/ft) Ww = (Cond Dia, in + 1 in ice) x 1ft/12 in x 4 psf (Section 6.1.10 "Transverse") H = conductor attachment height (ft) 3-primaries:3 x 1.75 x 150 x 0.5977 x 33.5 = 15,767 1-secondary: 1.75 x 150 x 0.6767 x 27.3 = 4,849 1-CATV: 1.75 x 150 x 0.6897 x 24.0 = 4,345 1-Fiber optic cable: 1.75 x 150 x 0.7297 x 23.0 = 4,405 1-400 pair tel. cable: 1.75 x 150 x 1.1150 x 22.0 = 6439 1-400 pair tel. cable: 1.75 x 150 x 1.1150 x 21.0 =6146 1-400 pair tel. cable: 1.75 x 150 x 1.1150 x 21.0 = 5,854 ft-lbs Total groundline moment = **47,806 ft-lbs**

Supersedes 7/11 Issue -Revised Example 1.

Supersedes 7/15 Issue – Corrected calculation error in Step 6.

3	Calculate ground line moment due to transverse line tension from 3° line angle.	Moment = $F_w \times W_t \times$ H x sine 3° ÷ 2 F_w = NESC overload factor for wind load W_t = NESC Heavy wire tension (lbs) H = equipment attachment height (ft) 3-primaries: 3 x 1.3 x 2,000 x 0.0262 x 33.5 = 6,838 ft-lbs 1-secondary: 1.3 x 2,000 x 0.0262 x 27.3 = 1,857 ft-lbs 1-CATV: 1.3 x 2,000 x 0.6897 x 24.0 = 1,633 ft-lbs 1-Fiber optic cable: 1.3 x 2,000 x 0.0262 x 23.0 = 1,565 ft-lbs 1-400 pair tel. cable: 1.3 x 2,000 x 0.0262 x 22.0 = 1,497ft-lbs 1-400 pair tel. cable: 1.3x 2,000 x 0.0262 x 21.0 = 1,429ft-lbs 1-400 pair tel. cable: 1.3x 2,000 x 0.0262 x 20.0 = 1,361ft-lbs Total groundline moment **= 16,179 ft-lbs**
4	Calculate the groundline moment due to the equipment wind load.	Moment = $F_w \times W_e \times$ H F_w = NESC overload factor for wind load (Table 1.) W_e = transverse equipment loading (lbs) (Table 6) H = equipment attachment height (ft) 1-50 kVA single-phase xfmr - 1.75 x 44 x 29.5 = 2272 Total groundline moment = **2,272 ft-lbs**
5	Calculate the bending moment due to the equipment offset.	Moment = $F_v \times$ weight of equipment × (d/12) F_v = NESC overload factor for vertical loads d = distance from the center of equipment to the center of pole (inches) 1-50 kVA single-phase xfmr - 1.90 x 750 x 16/12 = 1,900 Total bending moment = **1,900 ft-lbs**
6	Calculate the pole's groundline moment due to the wind load.	Use Table 4. (See foot note in table) Try Class 3 first. Total groundline moment = **2,934 ft-lbs**
7	Calculate total applied moment at groundline. (Sum of steps 2 through 6)	47,806 + 16,179 + 2,272 + 1,900 + 3,697 = **71,091 ft-lbs**
8	Find the permitted moment of pole at groundline by using Table 5.	40 foot Class 3 pole = 81,600 ft-lbs (Table 5) Permitted moment > Calculated moment **81,600ft-lbs>71,091 ft-lbs** Since the permitted moment capacity of the wood pole at groundline is larger than the applied moments, 40 foot Class 3 is adequate

Example 2 (This is the same example as above expect that Grade B construction applies.)

Given:

Determine the class of pole required to support the following wires and equipment on a 40 foot, unguyed wood pole with a 150 foot wind span for Grade B construction (non-crossing) under heavy loading conditions (4 lbs/sf wind, ½" radial ice). Assume a 3 degree line angle.

3-477 kcmil Al AAC bare conductors - 33.5' attachment height
(Outside phases are the same horizontal distances from the pole, therefore no bending moment is created)
3/C-1/0 triplex secondary - 27.3' attachment height
0.750-1/4" messenger (CATV) - 24.0' attachment height
134-216 fiber optic and 1/4" messenger telephone cable - 23.0' attachment height
400 pair, #22 AWG and 3/8" messenger telephone cable - 22.0' attachment height
400 pair, #22 AWG and 3/8" messenger telephone cable - 21.0' attachment height
400 pair, #22 AWG and 3/8" messenger telephone cable - 20.0' attachment height
1-50 kVA single-phase transformer - 29.5' attachment height
- 16" from the center of transformer to the center of pole

Step	Action	Use
1	Check the pole strength due to the transformer vertical load: The weight of the transformer is 750 lbs. Check the allowable weight that can be mounted from 4.5 feet (54 inches) from the top of the pole by using Table 3. Try Class 5 first.	Transformer weight = 750 lbs Allowable weight = **2085 lbs** Class 5 is adequate for vertical load. (This case will most likely not govern since vertical load typically do not govern for unguyed poles.)
2	Calculate the groundline moment due to the conductor wind load.	Moment = $F_w \times S_w \times W_w \times H$ F_w = NESC overload factor for wind load (See Section 2, Table 1.) S_w = wind span length (ft) W_w = transverse conductor loading (lbs/ft) Ww = (Cond Dia, in + 1 in ice) x 1ft/12 in x 4 psf (Section 6.1.10 "Transverse") H = conductor attachment height (ft) 3-primaries:3 x 2.50 x 150 x 0.5977 x 33.5 = 22,525 ft-lbs 1-secondary: 2.50 x 150 x 0.6767 x 27.3 = 6,927 ft-lbs 1-CATV: 2.5 x 150 x 0.6897 x 24.0 = 6,207 ft-lbs 1-Fiber optic cable: 2.50 x 150 x 0.7297 x 23.0 = 6,293 ft-lbs 1-400 pair tel. cable: 2.50 x 150 x 1.1150 x 22.0 = 9,199 ft-lbs 1-400 pair tel. cable: 2.50 x 150 x 1.1150 x 21.0 = 8,781 ft-lbs 1-400 pair tel. cable: 2.50 x 150 x 1.1150 x 20.0 = 8,363 ft-lbs Total groundline moment = **68,294 ft-lbs**
3	Calculate ground line moment due to transverse line tension from 3° line angle.	Moment = $F_w \times W_t \times$ H x sine 3° ÷ 2 F_w = NESC overload factor for wind load W_t = NESC Heavy wire tension (lbs) H = equipment attachment height (ft) 3-primaries: 3 x 1.65 x 2,000 x 0.0262 x 33.5 = 8,679 ft-lbs 1-secondary: 1.65 x 2,000 x 0.0262 x 27.3 = 2,357 ft-lbs 1-CATV: 1.65 x 2,000 x 0.6897 x 24.0 = 2,073 ft-lbs 1-Fiber optic cable: 1.65 x 2,000 x 0.0262 x 23.0 = 1,986 ft-lbs
4	Calculate the groundline moment due to the equipment wind load.	Moment = $F_w \times W_e \times$ H F_w = NESC overload factor for wind load (Table 1.) W_e = transverse equipment loading (lbs) (Table 6)

Supersedes 7/11 Issue - New Example 2

		H = equipment attachment height (ft) 1-50 kVA single-phase xfmr – 2.5 x 44 x 29.5 = 3,245 ft-lbs Total groundline moment = **3,245 ft-lbs**
5	Calculate the bending moment due to the equipment offset.	Moment = $F_w \times W_e \times H$ F_w = NESC overload factor for wind load (Table 1.) W_e = transverse equipment loading (lbs) (Table 6) H = equipment attachment height (ft) 1-50 kVA single-phase xfmr – 2.5 x 44 x 29.5 = 3,245 ft-lbs Total groundline moment = **3,245 ft-lbs**
6	Calculate the pole's groundline moment due to the wind load.	Moment = $F_v \times$ weight of equipment $\times$ (d/12) F_v = NESC overload factor for vertical loads d = distance from the center of equipment to the center of pole (inches) 1-50 kVA single-phase xfmr - 1.5 x 750 x 16/12 = 1,500 Total bending moment = **1,500 ft-lbs**
7	Calculate total applied moment at groundline. (Sum of steps 2 through 6)	68,294 + 20,535 + 3,245 + 1,500 + 5,245 = 98,819 ft-lbs
8	Find the permitted moment of pole at groundline by using Table 5.	40 foot Class H1 pole = 172,800 x 0.765 ft-lbs (Table 5 – *see foot note*) = **98,819 ft-lbs** Permitted moment > Calculated moment **132,192 ft-lbs> 98,819 ft-lbs** **Since the permitted moment capacity of the wood pole at groundline is larger than the applied moments, 40 foot Class H1 is adequate**

Example 3.

Given:

Determine the class of pole required to support the following wires and equipment on a 45 foot, unguyed wood pole with a 150 foot wind span for Grade B construction (non-crossing) under heavy loading conditions (4 lbs/sf wind, ½" radial ice). Assume a 3 degree line angle.

Double circuit Spacer Cable 6-477 kcmil Al AAC bare conductors - 38.5' attachment height
(Outside phases are the same horizontal distances from the pole, therefore no bending moment is created)
3/C-1/0 triplex secondary - 32.3' attachment height
0.750-1/4" messenger (CATV) - 28.0' attachment height
134-216 fiber optic and 1/4" messenger telephone cable - 27.0' attachment height
400 pair, #22 AWG and 3/8" messenger telephone cable - 26.0' attachment height

Step	Action	Use
1	Calculate the groundline moment due to the conductor wind load.	Moment = $F_w \times S_w \times W_w \times$ H F_w = NESC overload factor for wind load (See Section 2, Table 1.) S_w = wind span length (ft) W_w = transverse conductor loading (lbs/ft) Ww = (Cond Dia, in + 1 in ice) x 1ft/12 in x 4 psf (Section 6.1.10 "Transverse") H = conductor attachment height (ft) 2-Messenger wires: 2 x 2.5 x 150 x 0.04957 x 38.5 = 14,312 6-primaries: 6 x 2.50 x 150 x 0.6807 x 38.5 = 58,963 1-secondary: 2.50 x 150 x 0.6767 x 32.3 = 8,196 1-CATV: 2.5 x 150 x 0.6897 x 28.0 = 7,242 1-Fiber optic cable: 2.50 x 150 x 0.7297 x 27.0 = 7,388 1-400 pair tel. cable: 2.50x 150 x 1.1150 x 26.0 = 10,871 ft-lbs Total groundline moment = 106,972 ft-lbs
2	Calculate ground line moment due to transverse line tension from 3° line angle.	Moment = $F_w \times W_t \times$ H x sine 3° ÷ 2 F_w = NESC overload factor for wind load W_t = NESC Heavy wire tension (lbs) H = conductor attachment height (ft) 2-Messenger wires 3 x 1.65 x 2,000 x 0.0262 x 38.5 = 6,649 6-primaries6 x 1.65 x 2,000 x 0.0262 x 38.5 = 8,679 1-secondary: 1.65 x 2,000 x 0.0262 x 32.3 = 2,789 1-CATV: 1.65 x 2,000 x 0.6897 x 28.0 = 2,418 1-Fiber optic cable: 1.65 x 2,000 x 0.0262 x 27.0 = 2,332 1-400 pair tel. cable: 1.75 x 150 x 1.1150 x 26.0 = 2,245 ft-lbs Total groundline moment = 36,381 ft-lbs
3	Calculate the pole's groundline moment due to wind load.	Use Table 4. (See foot note in table) Try Class H1 Total groundline moment = 4,820x 1.43 = 6,893 ft-lbs
4	Total applied moment at groundline (sum of steps 1-3)	106,972 + 36,381 + 6,893 = 150,246 ft-lbs
5	Find the permitted moment of pole at groundline by using Table 5.	45 foot Class H1 pole = 197,100 x 0.765 ft-lbs (Table 5 – *see foot note*) = 150,782 ft-lbs 150,782 > 150,246 Use 45 Foot Class H1 Pole

Supersedes 7/11 Issue - New Example 3.

Supersedes 7/14 Issue – Corrected equipment weight typo for 45/H1 Cluster Mount 60”.

Table 3

MAXIMUM ALLOWABLE WEIGHT OF EQUIPMENT

POLE SIZE/CLASS	DISTANCE FROM TOP OF POLE TO THE TOP MOUNTING BOLT OF THE EQUIPMENT									
	SINGLE MOUNT WOOD POLES					CLUSTER MOUNT WOOD POLES				
	24”	36”	54”	60”	84”	24”	36”	54”	60”	84”
35/H1	5822	6351	7271	7705	9246	7889	8600	9837	10413	12488
35/1	5220	5580	6165	6365	7300	6960	7440	8220	8490	9730
35/2	4250	4530	5020	5190	5975	5665	6040	6695	6920	7970
35/3	3405	3640	4025	4170	4800	4540	4850	5370	5560	6395
35/4	2675	2870	3190	3305	3805	3570	3830	4255	4410	5070
40/H1	4860	5246	5898	6141	7252	6541	7056	7926	8250	9731
40/1	4445	4705	5150	5320	6020	5925	6270	6870	7100	8030
40/2	3620	3840	4215	4345	4930	4825	5120	5620	5795	6575
40/3	2900	3085	3400	3510	3980	3870	4115	4535	4680	5310
40/4	2300	2435	2680	2770	3160	3065	3245	3575	3695	4215
45/H1	4250	4440	4933	5108	5915	5550	5934	6587	6819	7887
45/1	3920	4135	4500	4620	5180	5225	5510	6000	6165	6905
45/2	3190	3390	3685	3790	4260	4255	4520	4915	5055	5685
45/3	2560	2710	2960	3030	3410	3416	3615	3945	4040	4545
45/4	2015	2140	2335	2405	2720	2690	2855	3110	3210	3630
50/H1	3605	3834	4217	4352	4965	4791	5092	5597	5775	6581
50/1	3505	3685	3995	4100	4560	4675	4915	5325	5465	6080
50/2	2840	3010	3255	3345	3720	3790	4015	4345	4460	4960
50/3	2280	2410	2615	2690	2990	3040	3210	3485	3585	3985
50/4	1805	1900	2075	2125	2385	2410	2535	2765	2830	3180
55/H1	3175	3359	3667	3774	4252	4195	4436	4838	4978	5603
55/1	2978	3154	3442	3544	4000	3945	4176	4553	4687	5285
55/2	2785	2949	3220	3317	3774	3698	3915	4271	4398	4960
55/3	2885	2738	2991	3083	3484	3441	3644	3978	4099	4628
	SINGLE MOUNT FIBERGLASS POLES					CLUSTER MOUNT FIBERGLASS POLES				
35/4	2740	2760	2800	2810	2895	3653	3680	3733	3747	3860
40/3	2380	2390	2415	2420	2475	3173	3187	3220	3227	3300
45/2	2580	2585	2605	2615	2660	3440	3447	3473	3487	3547

1. This table can be used for both Grade B and Grade C construction.
2. Based on 2’ lug spacing (for 3’ lug spacing see note 4).
3. Assumed that the bottom attachment point is the critical location for eccentric loading (2% deflection).
4. For 167kVA (219A) regulator cluster mounts add 5% to the values shown above (or multiply by 1.05) due to 3’ lug spacing.
5. Fiberglass pole information is from Roark, deflection for cantilever with applied moment

Table 4 Distribution Pole Groundline Moments Due To Wind Load (ft-lbs) (Set in Earth)							
	Class H1	**Class 1**	**Class 2**	**Class 3**	**Class 4**	**Class 5**	**Class 6**
35 foot	2693	2505	2330	2155	1979	1804	1643
40 foot	3668	3399	3166	2934	2701	2468	2236
45 foot	4820	4449	4151	3830	3532	3234	2936
50 foot	6156	5665	5264	4864	4492	4120	-----
55 foot	7691	7017	6529	6040	5586	-----	-----
60 foot	9372	8535	7950	7364	6778	-----	-----
65 foot	11186	10225	9533	8842	-----	-----	-----
70 foot	13195	12091	11285	10479	-----	-----	-----
Multiply these values by 1.26 for Grade C at-crossings and 1.43 for Grade B.							

Table 5 Distribution Pole Permitted Groundline Moments (ft-lbs) (Set in Earth)							
	Class H1	**Class 1**	**Class 2**	**Class 3**	**Class 4**	**Class 5**	**Class 6**
35 foot	145800	105188	86488	70125	56100	44413	35063
40 foot	172800	122400	100640	81600	65280	51680	40800
45 foot	197100	139613	114793	93075	74460	58948	46538
50 foot	221400	156825	128945	104550	83640	66215	-----
55 foot	245700	174038	143098	116025	92820	-----	-----
60 foot	270000	191250	157250	127500	102000	-----	-----
65 foot	294300	208463	171403	138975	-----	-----	-----
70 foot	318600	225675	185555	150450	-----	-----	-----
Multiply these values by 0.765 for Grade B for wood structures Multiply these values by 1.0 for fiberglass poles							

Supersedes 7/11 Issue - Added H1 Class poles to Tables 4, 5.

Table 6				
Transverse Equipment Loading For 4 lbs/sq. ft Wind Load				
EQUIPMENT	**Effective Area (sq. ft)**	**Load Reduction Factor**	**Reduced Eff. Area (sq. ft)**	**Transverse Equipment Load (lbs)**
Capacitor Bank 450kVAR Sw.	3	90%	3	12
Capacitor Bank 1200kVAR Sw.	7	85%	6	24
Floodlight (All)	3	90%	3	12
Gang Operated Switch	18	90%	16	65
Primary Metering	7	85%	6	24
Recloser three-phase	4	90%	4	16
Regulator - 76kVA(100A) single-phase	12	85%	10	40
Regulator - 167kVA(219A) single-phase	15	85%	13	52
Regulator - 3-76kVA(100A) three-phase	24	85%	20	80
Regulator - 3-167kVA(219A) three-phase	30	85%	26	104
Streetlight (All)	4	85%	3	13
Trans. single phase up to 75kVA	12	90%	11	44
Trans. single phase 100kVA and up	17	90%	15	60
Transformer 3-100kVA and up	34	90%	31	124

Table 7			
Common Telephone & CATV Cables Transverse Load Factor (Wind)			
Description		**Conductor Diameter (in.)**	**Transverse Load (lbs./ft.)**
#22 AWG and 3/8” Messenger	200 Pair	1.815	0.938
	300 Pair	2.115	1.038
	400 Pair	2.345	1.115
#24 AWG and 3/8” Messenger	600 Pair	2.295	1.098
	900 Pair	2.685	1.228
Fiber Optic and ¼” Messenger (non-armored)	3-36	0.640	0.547
	38-72	0.739	0.580
	74-84	0.781	0.594
	86-96	0.820	0.607
	98-108	0.850	0.617
	110-120	0.889	0.630
	122-132	0.931	0.644
	134-216	0.979	0.660
	218-264	1.045	0.682
Fiber Optic and 3/8” Messenger (non-armored)	144	1.159	0.720
Fiber Optic Self Supporting Figure “8” Cable (non-armored)	2-72 & 2-36	0.949	0.650
	74-84	0.991	0.664
	86-96	1.030	0.677
	98-108	1.060	0.687
	110-120	1.099	0.700
	122-132	1.141	0.714
	134-144	1.189	0.730
¼” Messenger (CATV)	0.750	1.069	0.690
	0.635	0.883	0.628
	0.500	0.751	0.584
	0.412	0.652	0.551

CU = PW(A)(B)	Distribution Wood Pole, (A)=Pole Length, (B)=Pole Class

ANSI 05.1 POLE CLASS (see Note 2)	**CLASS H1**	**CLASS 1**	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**	**CLASS 6**
Minimum Top Circumference	29 in.	27 in.	25 in.	23 in.	21 in.	19 in.	17 in.
Minimum Top Diameter	9.2 in.	8.6 in.	8 in.	7.3 in.	6.7 in.	6 in.	5.4 in.
Breaking load in lbs. @ 2 feet from top for unguyed poles set in earth at standard setting depth.	5400 #	4500 #	3700 #	3000 #	2400 #	1900 #	1500 #

Southern Yellow Pine and Douglas Fir Poles (Ultimate Fiber/Bending Stress = 8000 psi)

Pole Length	Setting Depth (Feet)			Minimum Circumference in inches as measured 6 feet from the pole butt						
(Feet)	In Earth	In Rock	Wet Soil	H1	CL1	CL2	CL3	CL4	CL5	CL6
35	6	4	8	41.5	39	36.5	34	31.5	29	27
40	6	4	8	43.5	41	38.5	36	33.5	31	28.5
45	6.5	4.5	8.5	45.5	43	40.5	37.5	35	32.5	30
50	7	4.5	9	47.5	45	42	39	36.5	34	-----
55	7.5	5	9.5	49.5	46.5	43.5	40.5	38	-----	-----
60	8	5.5	10	51	48	45	42	39	-----	-----
65	8.5	6	10.5	52.5	49.5	46.5	43.5	-----	-----	-----
70	9	6.5	11	54	51	48	45	-----	-----	-----

Western Red Cedar Poles (Ultimate Fiber/Bending Stress = 6000 psi)

Pole Length (Feet)	Setting Depth (Feet)			Minimum Circumference in inches as measured 6 feet from the pole butt						
	In Earth	In Rock	Wet Soil	H1	CL1	CL2	CL3	CL4	CL5	CL6
35	6	4	8	45.5	42.5	40	37.5	34.5	32	30
40	6	4	8	48	45	42.5	39.5	36.5	34	31.5
45	6.5	4.5	8.5	50	47.5	44.5	41.5	38.5	36	33
50	7	4.5	9	5	49.5	46.5	43.5	40	37.5	-----
55	7.5	5	9.5	52.5	51.5	48.5	45	42	-----	-----

1. See Page 2-102 for weights for common pole sizes and wood species and Section 22.
2. Class and technical data taken from current ANSI specification 05.1. Poles are classed according to minimum size and minimum breaking load capacity. All poles of the same class shall have the same strength. Pole species of lower ultimate fiber (bending) strength will be larger in diameter than stronger/harder specie poles.
3. Basic formulas for area and diameter calculations are: $A=\pi r^2$, $C=\pi D$, and $D=C/\pi$.
4. Poles that are to be located in areas that are very wet or in areas that have standing water should be referred to Standards Engineering as they may require the use of multiple pole guys or foundation supports.

Supersedes 7/08 Issue - Added H1 Class poles to Table.

POLE LENGTH	POLE LIFTING SUPPORT LOCATION (Measured in feet from butt)	AVERAGE WEIGHT IN POUNDS						
		FULL LENGTH TREATED SOUTHERN YELLOW PINE POLES						
		CLASS H1	CLASS 1	CLASS 2	CLASS 3	CLASS 4	CLASS 5	CLASS 6
25		-----	777	671	582	512	442	371
30		-----	1024	901	777	671	582	512
35	16	1572	1324	1148	985	865	742	636
40	18.5	1942	1642	1430	1236	1077	936	794
45	20.5	2278	1977	1713	1483	1289	1112	-----
50	22	2666	2348	2030	1766	1536	1494	-----
55	23	3054	2737	2384	2066	1784	-----	-----
60	14 & 45	3461	3160	2720	2366	2048	-----	-----
65	14 & 47.5	3902	3584	3108	2702	-----	-----	-----
70	15 & 50	4362	4044	3514	3037	-----	-----	-----
		FULL LENGTH TREATED DOUGLAS FIR POLES						
30		-----	920	820	664	552	452	352
35	16	1342	1060	1004	804	708	608	524
40	18.5	1681	1340	1256	1016	888	776	664
45	20.5	1907	1680	1524	1228	1060	932	-----
50	22	2147	1936	1780	1412	1228	-----	-----
55	23	2500	2160	2036	1612	1400	-----	-----
60	14 & 45	3008	2372	2304	1836	1568	-----	-----
65	14 & 47.5	3392	2668	2584	1836	-----	-----	-----
70	15 & 50	3812	3024	2880	2344	-----	-----	-----
		FULL LENGTH TREATED WESTERN RED CEDAR POLES						
30		-----	-----	-----	501	428	375	328
35	16	-----	829	728	636	549	482	426
40	17.5	-----	1022	899	776	675	602	535
45	19.5	-----	1224	1070	935	815	728	-----
50	21.5	1624	1448	1271	1098	958	871	-----
55	23	1884	1674	1464	1277	1128	-----	-----
60	14 & 45	2156	1912	1669	1453	1278	-----	-----
65	14 & 47.5	2430	2156	1882	1638	-----	-----	-----
70	15 & 50	2736	2422	2108	1842	-----	-----	-----
		FIBERGLASS POLES						
35	17.5	-----	-----	-----	-----	350	-----	-----
40	20	-----	-----	-----	450	-----	-----	-----
45	22.5	-----	-----	700	-----	-----	-----	-----

Supersedes 7/11 Issue – Added H1 Class poles.

1. Detailed wood pole specifications are published in ANSI 05.1 and by The American Wood Preserver's Association (AWPA).
2. When lifting poles, care must be taken to avoid excessive bending and the possibility of cracking. Poles shorter than 60 feet may be picked up at the center of gravity of the pole. Poles 60 feet and longer shall be picked up at two points, listed in the above Table under Center Of Gravity.
3. Extremely wet wood poles may exceed maximum weights by 100-300 pounds.

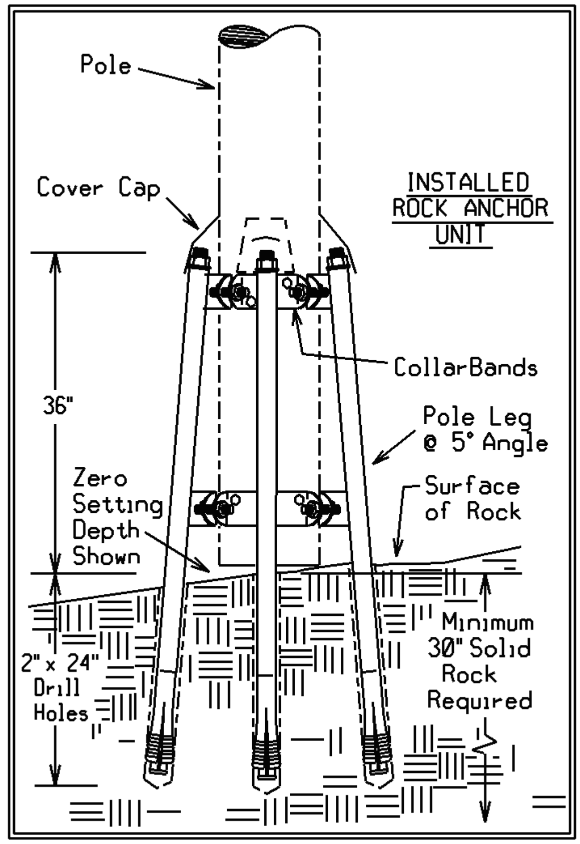
CU = PMNT3P14A	3 Anchor Leg
CU = PMNT4P14A	4 Anchor Leg
CU = PMNT5P14A	5 Anchor Leg

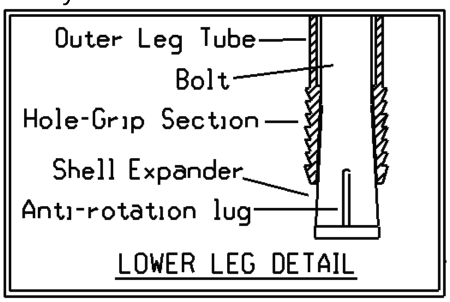
When Distribution poles are to be set in areas where sound bedrock is at or near the surface, the pole rock anchor (Item P14A) is recommended. Rock anchors may be installed above or below grade and, when properly installed, provide anchorage equaling or exceeding standard soil installations.

Failure to use all of the packaged hardware or to adhere to the following procedure will result in an improper installation.

The anchor assembly may be bonded to grounding conductors but shall not be considered as a grounding component.

The Drilling Template (Items P14AT - P14CT) must be ordered separately and shall be retained for future re-use.





Selection and Installation

1. Location must allow 24” deep anchor leg holes drilled into (a 30” minimum thickness of) strong, solid rock. Pole butt must rest on rock surface at some point and rock shall slope not more than 3” across pole diameter. Non-solid rock or soil overburden must be removed to expose the solid rock. Pole anchor may be installed above or below grade but the legs shall be installed into 24” of solid rock. Reduced or zero setting depth may reduce pole length required, allowing selection of a shorter pole.

2. Measure pole butt diameter approximately 6” from butt end to determine the number of anchor legs required. For 8” to 12” diameter poles, use 3 anchor legs. 11” to 16” diameter poles, use 4 legs. 15” to 20” diameter poles, use 5 legs.

3. Adjust the Drilling Template to the pole butt diameter (as measured 6” from butt end). Place the template on the rock and adjust to level. Drill the first hole (sloping outward) at the highest hole location (if location is not level) to a 24” depth. Dill holes must be in solid, hard rock.

4. Place two anchor legs into drilled holes and loosely connect their collarbands.

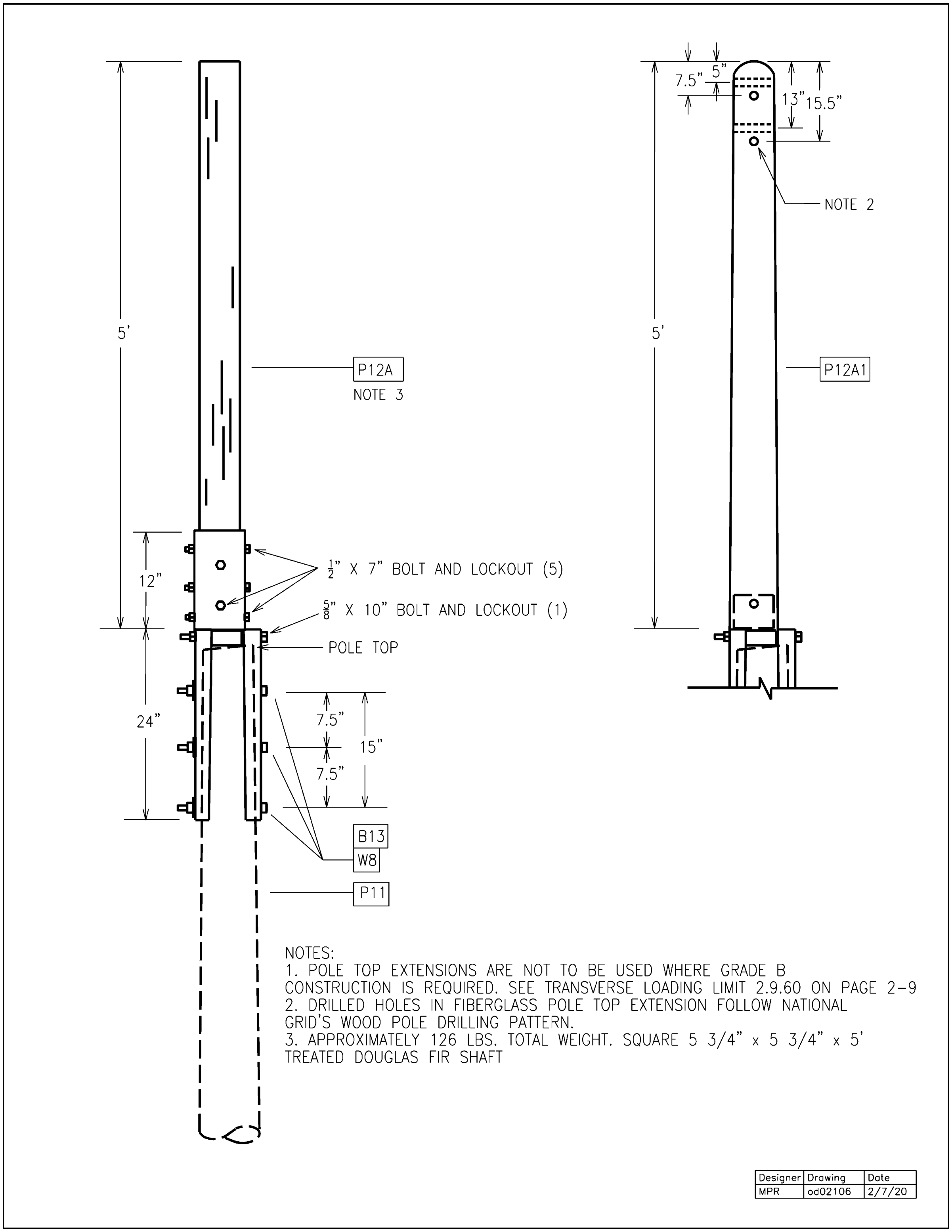
5. Install pole in place, plumb, and hold in position. Install remaining anchor leg(s) and tighten interconnecting band bolts - sufficiently to slightly deflect band collars.

6. Rigorously tighten the large nuts at the top of anchor legs to force open the expansion shields at leg bottom ends. If sufficient force (torque) is not developed, unsound rock is indicated.

7. Install **all** remaining lag bolts.

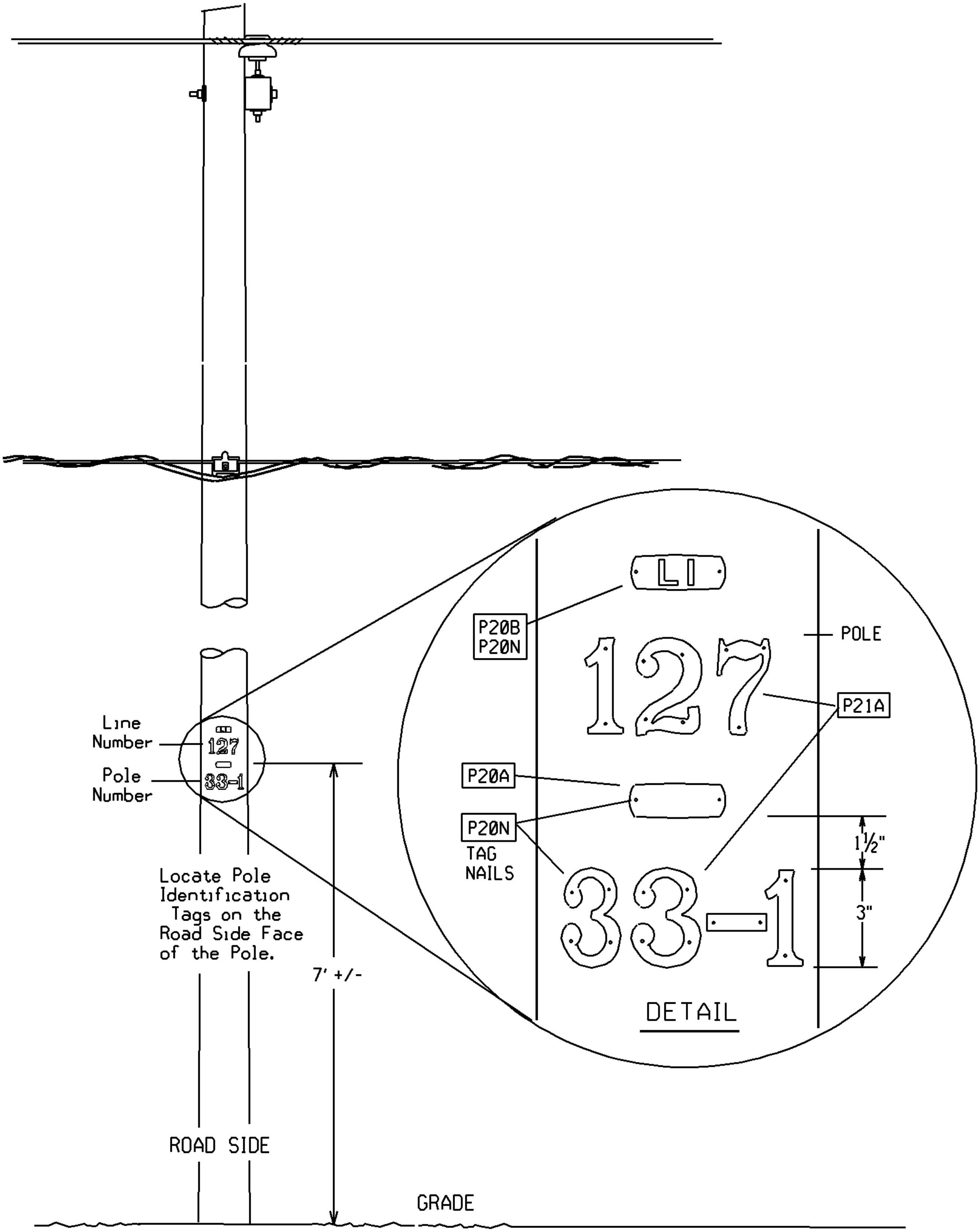
8. Install anchor leg top covers. Install rock anchor identification tag (Std Item P25) just below the pole number tags. The identification tag is especially important if rock anchor assembly is buried in the future and may not be visible. Anchor bolt holes may be grouted where ice may be a concern.

9. Guy all angles and deadends as required per Section 3.



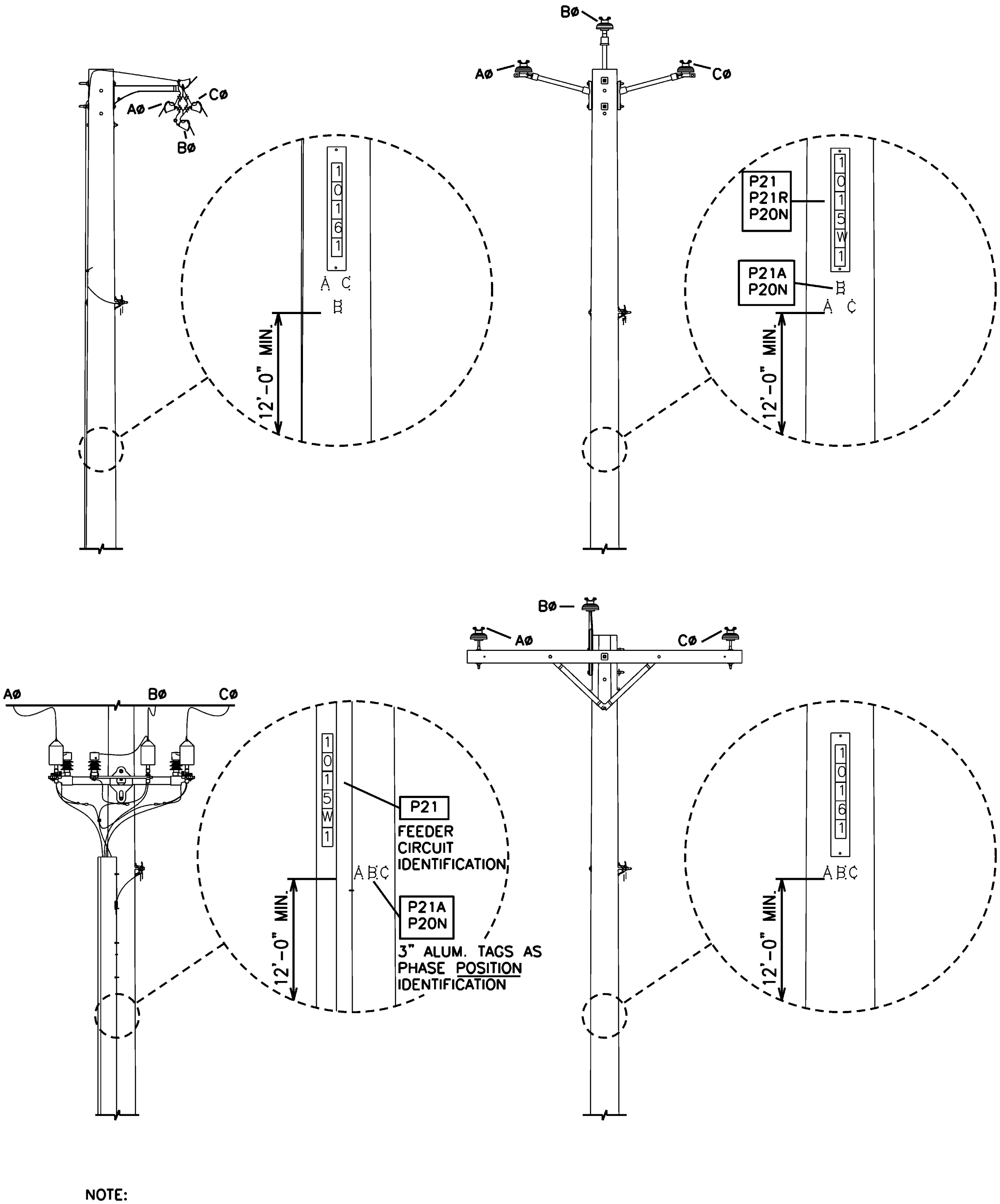
NOTE: Pole top extensions are not to be used where Grade B Construction is required.

Supersedes 7/19 Issue – Added note on transverse loading



02-111

Supersedes 1/07 Issue – Changed Company Tag Name

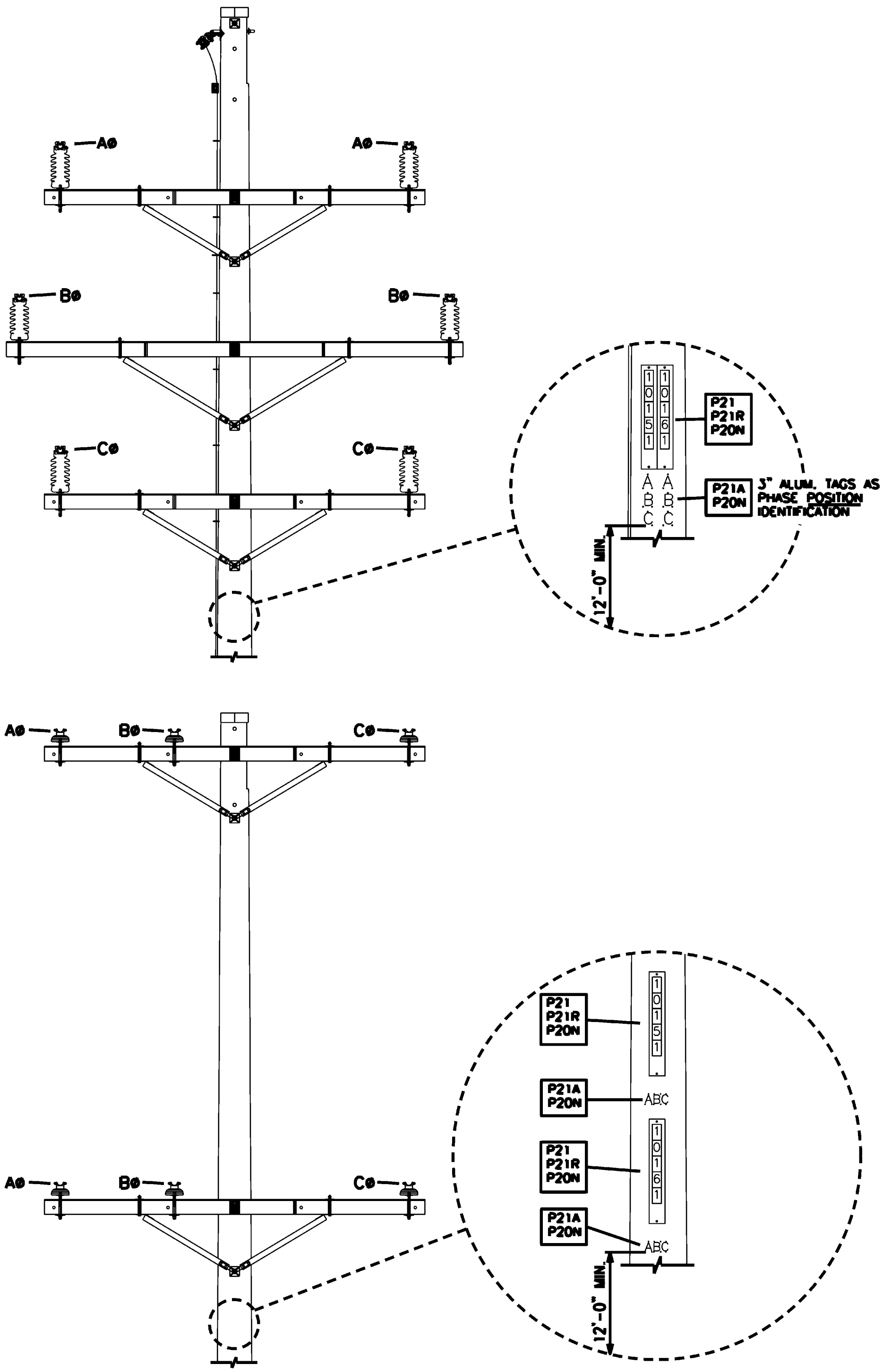


NOTE:

1. SHOWN HERE ARE STANDARD PHASE AND FEEDER IDENTIFICATION DETAILS WHEN SUCH APPLICATIONS ARE APPROPRIATE. SEE PARA. 2.1.30 FOR FURTHER INFORMATION.

Designer	Drawing	Date
MPR	od02112	7/15/19

New drawing added.



NOTE:

1. SHOWN HERE ARE STANDARD PHASE AND FEEDER IDENTIFICATION DETAILS WHEN SUCH APPLICATIONS ARE APPROPRIATE. SEE PARA. 2.1.3 FOR FURTHER INFORMATION.

Designer	Drawing	Date
MPR	od02112A	7/15/19

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Notes:

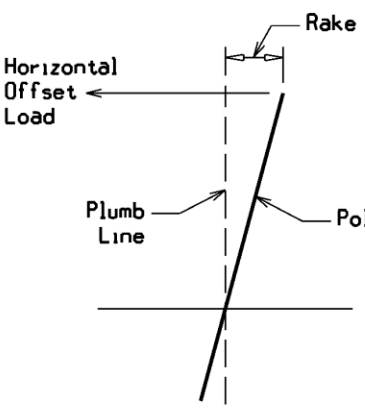
1. All holes shall be predrilled 11/16" diameter for 5/8" bolts, unless otherwise staded. Fiberglass shall be reinforced at holes if necessary and predrilled holes shall be capped with permanent-removable caps.

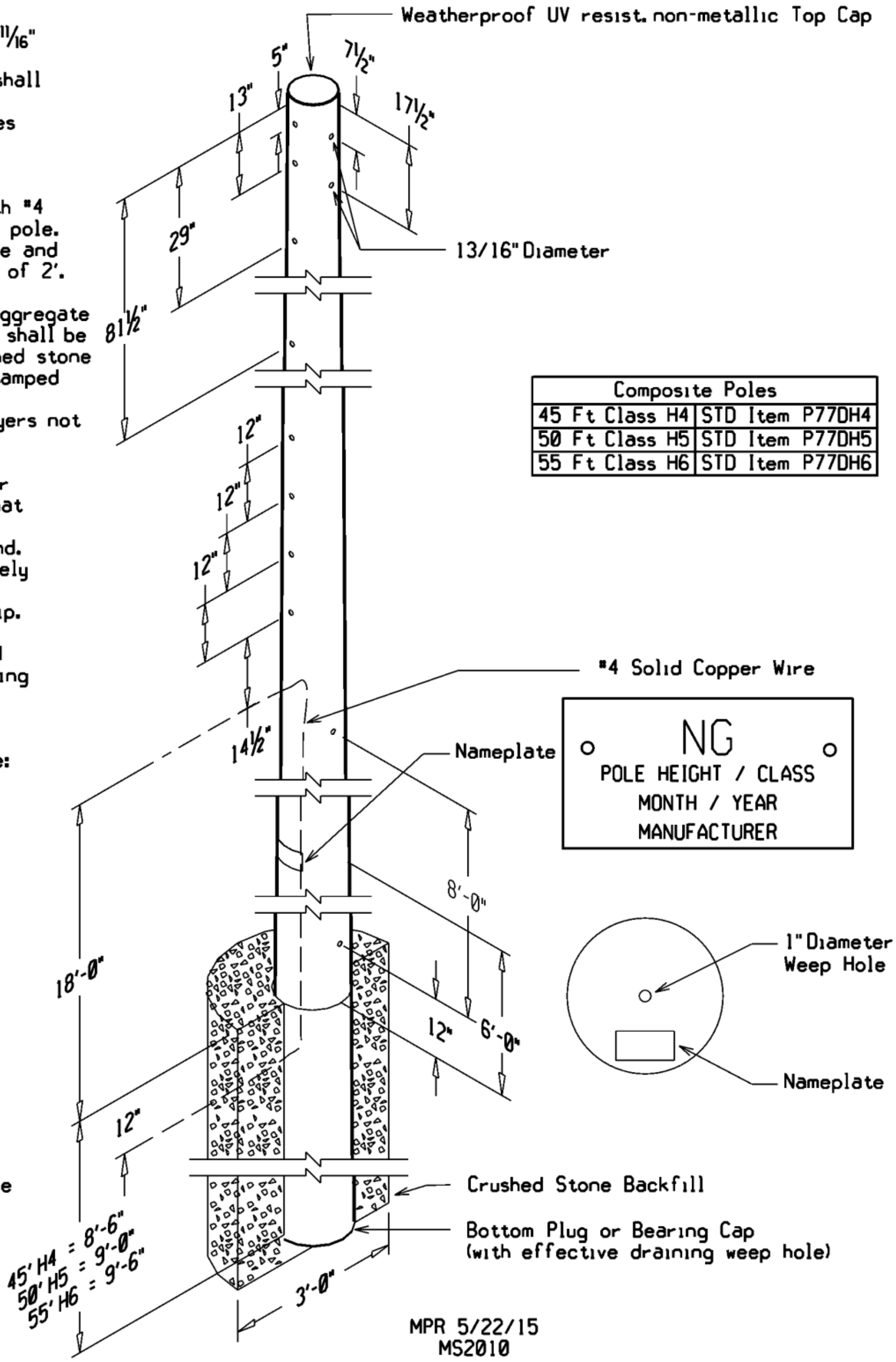
2. Poles shall come equipped with #4 solid copper wire internal to pole. Wire shall exit 12" below grade and 18' above grade for a length of 2'.

3. Crushed stone backfill with aggregate not exceeding 3/4" in diameter shall be used to back fill poles. Crushed stone backfill shall be thoroughly tamped using mechanical tampers or appropriate hand tools in layers not exceeding 12" in depth.

4. Poles with line angles greater than 10° shall be raked so that they are plumb when weather conditions are at 60°F, no wind. The poles deflect approximately 6" per 1,000 lbs. horizontal offset load applied at the tip. Designers may determine the resultant offset load applied and prescribe a rake according to this deflection rate. Alternatively, the following table may be used to approximate installation rake:

Line Angle Range, degrees	Rake
0-10	Plumb
10-30	6"
30-60	1'-0"
60-90	1'-6"
90-120	2'-0"
120-180	2'-6"





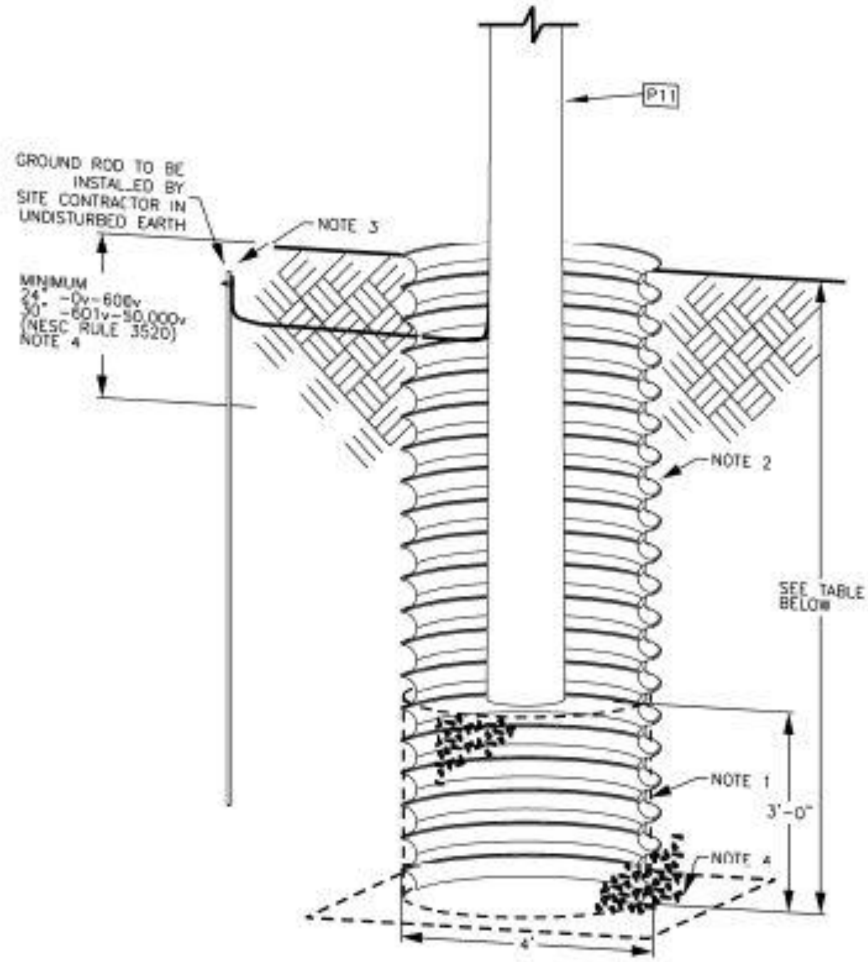
Composite Poles	
45 Ft Class H4	STD Item P77DH4
50 Ft Class H5	STD Item P77DH5
55 Ft Class H6	STD Item P77DH6

Supersedes 7/16 Issue. Corrected title error.

SELF SUPPORTING FIBERGLASS POLES

ISSUE	PAGE NUMBER		
7/17	2-113	OVERHEAD CONSTRUCTION STANDARD	ppl

New drawing added.



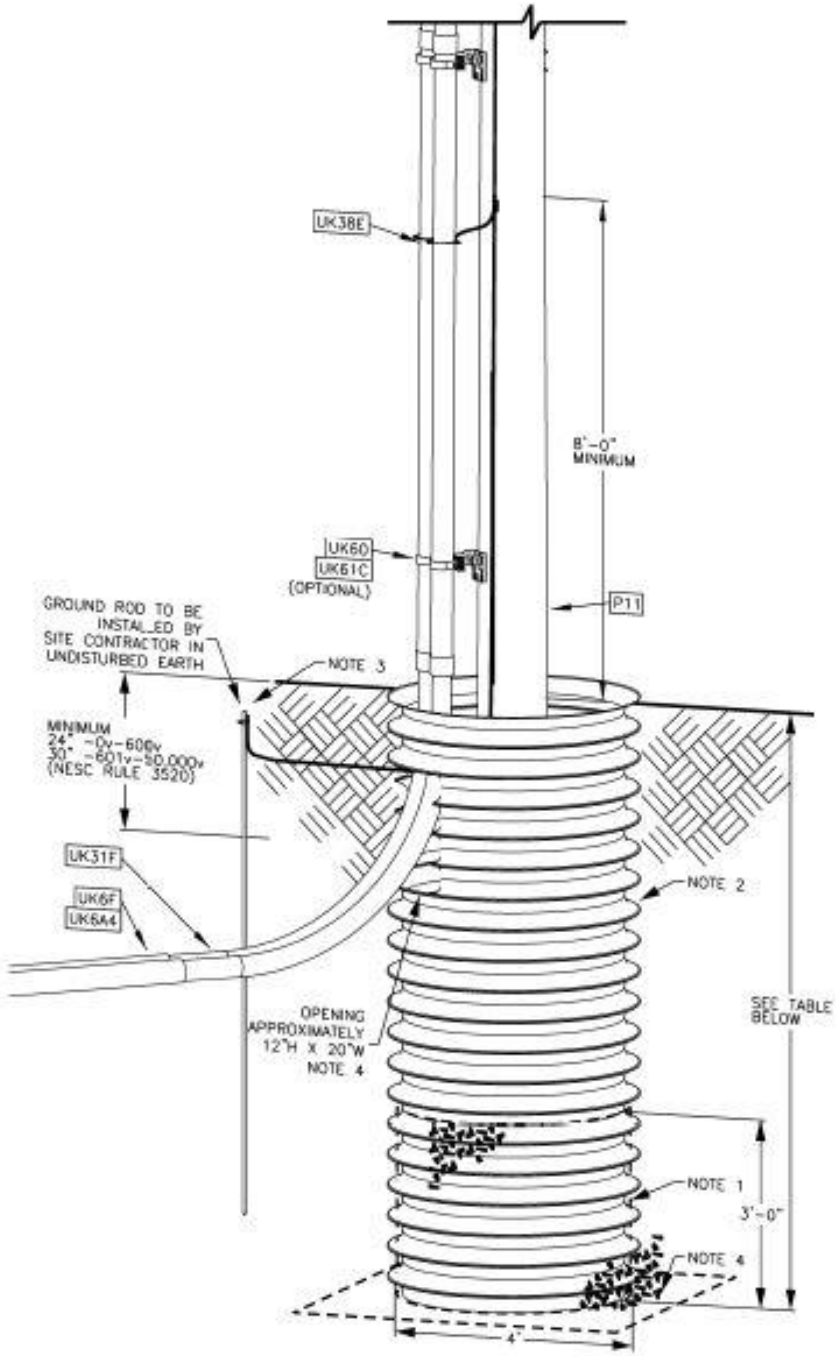
CORRUGATED METAL PIPE DEPTH TABLE

POLE HEIGHT	SET DEPTH
40'	9'-0"
45'	9'-6"
50'	10'-0"
55'	10'-6"

NOTES:

1. CRUSHED STONE BACKFILL WITH AGGREGATE NOT EXCEEDING ¾" IN DIAMETER SHALL BE USED TO BACK FILL POLES. CRUSHED STONE BACKFLL SHALL BE THOROUGHLY TAMPED USING MECHANICAL TAMPERS OR APPROPRIATE HAND TOOLS IN LAYERS NOT EXCEEDING 12" IN DEPTH.
2. CORRUGATED METAL PIPE WITH CORRUGATIONS 2- ⅔" X ½", MINIMUM 16 GUAGE.
3. SEE 13-114 FOR GROUND DETAILS.
4. INSTALL GEOTEXTILE FABRIC AS A BARRIER ON ALL CORRUGATED METAL PIPE OPENINGS.
5. UTILITY CREWS TO INSTALL POLE AND CONNECT TO GROUNDING ALREADY INSTALLED WITH CORREGATED PIPE, GEOTEXTILE BARRIER AND CRUSHED STONE BACKFILL.
6. CORRUGATED STEEL PIPE SHALL BE FREE OF ALL BURS AND JAGGED EDGES IN ORDER TO REDUCE THE RISK OF CUTTING INJURIES DURING HANDLING. CORRUGATED PIPE SHALL BE FITTED WITH EDGE TRIM SUCH AS NEOPRENE RUBBER TO COVER BURS AND JAGGED EDGES.

Designer	Drawing	Date
MPR	od02301	6/30/20



New Drawing added.

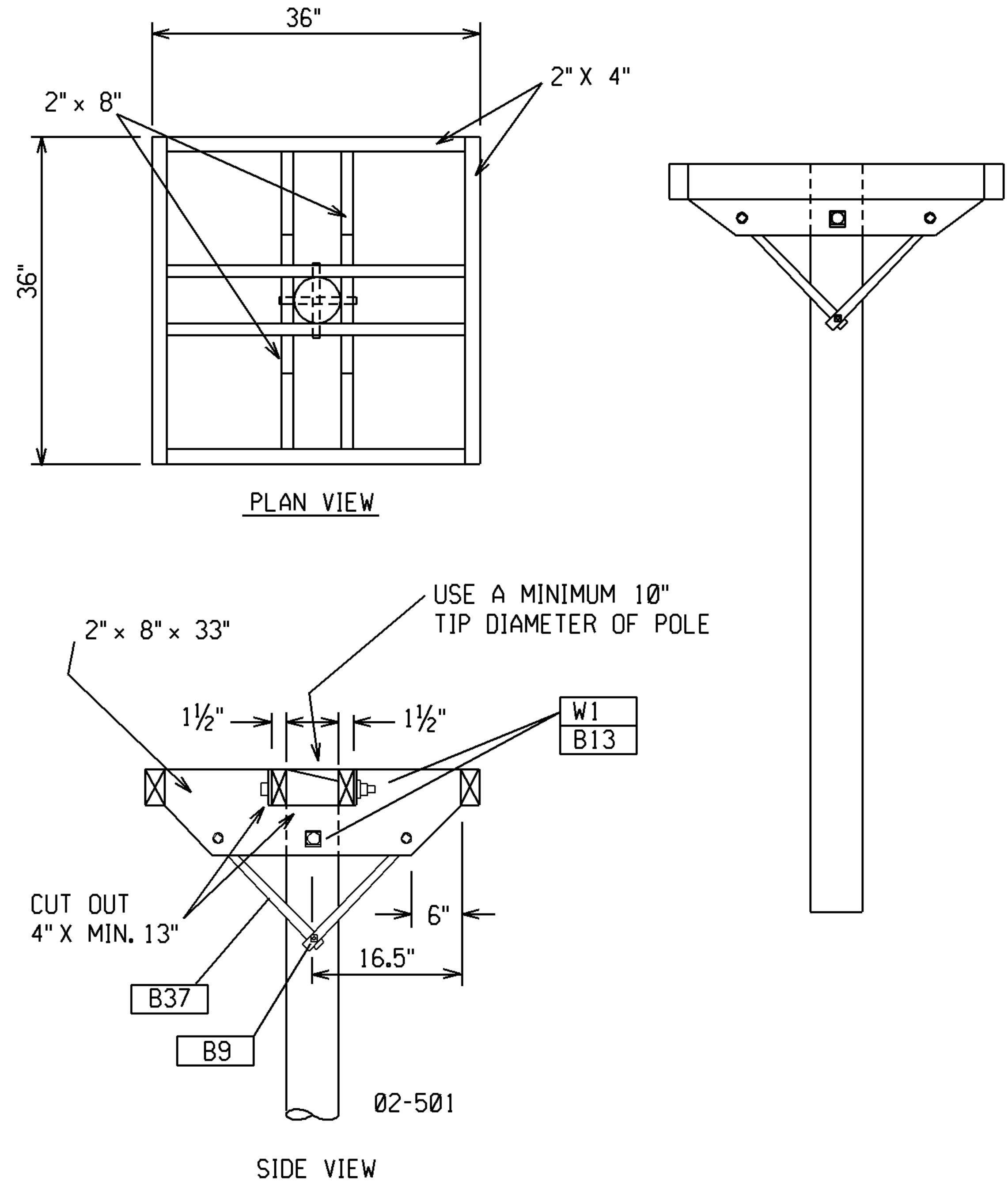
CORRUGATED METAL PIPE DEPTH TABLE

POLE HEIGHT	SET DEPTH
40'	9'-0"
45'	9'-6"
50'	10'-0"
55'	10'-6"

NOTES:

1. CRUSHED STONE BACKFILL WITH AGGREGATE NOT EXCEEDING ¾" IN DIAMETER SHALL BE USED TO BACK FILL POLES. CRUSHED STONE BACKFILL SHALL BE THOROUGHLY TAMPED USING MECHANICAL TAMPERS OR APPROPRIATE HAND TOOLS IN LAYERS NOT EXCEEDING 12" IN DEPTH.
2. CORRUGATED METAL PIPE WITH CORRUGATIONS 2- ⅔" X ½". MINIMUM 16 GUAGE.
3. SEE 13-114 FOR GROUND DETAILS.
4. INSTALL GEOTEXTILE FABRIC AS A BARRIER.
5. CORRUGATED STEEL PIPE SHALL BE FREE OF ALL BURS AND JAGGED EDGES IN ORDER TO REDUCE THE RISK OF CUTTING INJURIES DURING HANDLING. CORRUGATED PIPE SHALL BE FITTED WITH EDGE TRIM SUCH AS NEOPRENE RUBBER TO COVER BURS AND JAGGED EDGES.

Designer	Drawing	Date
MPR	od02301A	6/30/20

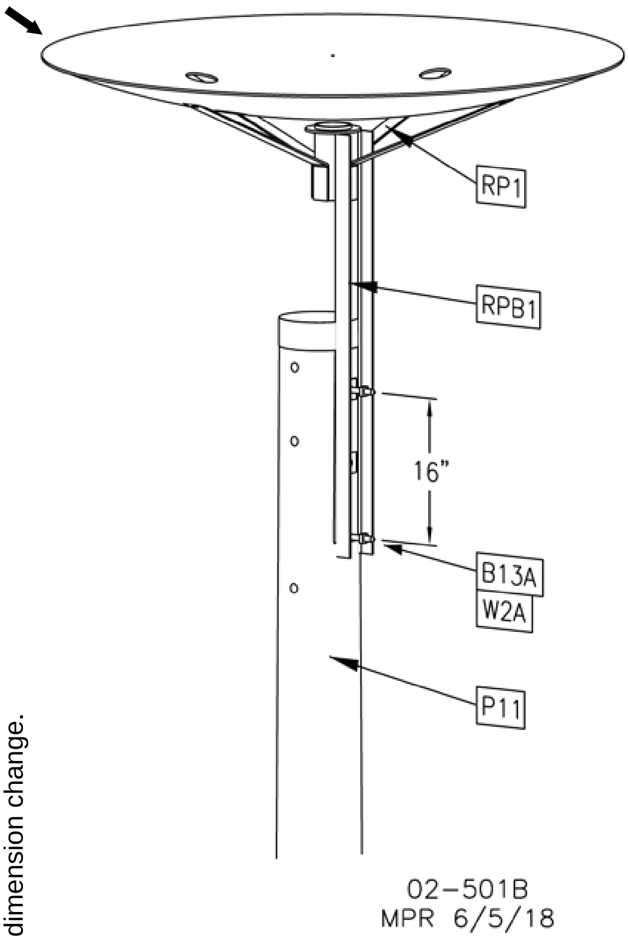


Supersedes 7/11 issue – Drawing title correction.

NOTES:

1. Platform shall be installed onto a separate pole set adjacent to line.
2. Platform shall utilize pressure treated lumber and all joints shall be properly fastened using #8 x 3" galvanized wood screws and glue. All screw holes shall be predrilled to prevent splitting.
3. Staple a 36" x 36" piece of 2" x 4" galvanized wire mesh over the top of the platform using 1" galvanized wire staples (fencing staples).

NESTING PLATFORM – WOOD FRAME			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 2-501	ISSUE 7/21



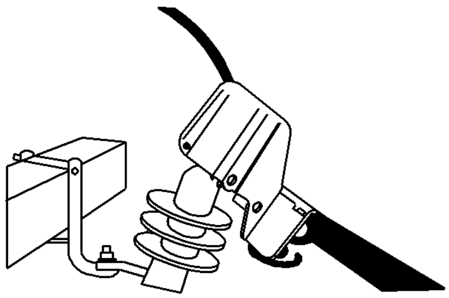
Supersedes 7/16 Issue – Drawing dimension change.

Notes:

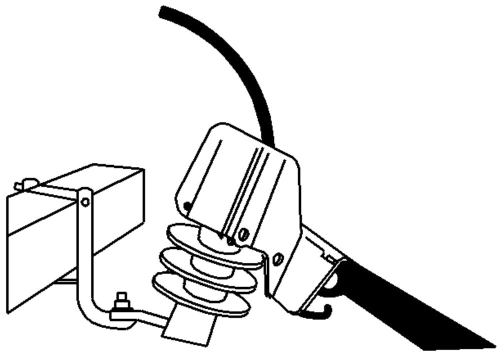
1. The primary option shall be to install platform on a separate pole nearby line.
2. If an independent pole is not possible, the platform may be installed directly on pole carrying energized lines. It is recommended that work be performed with the line de-energized.
3. For distribution voltages up to 15kV, maintain a minimum of 12-inches clearance in any direction between a phase conductor and any part of the platform, the supporting bracket or the through bolts.
4. For clearances greater than 15kV, consult NESC Table 235-6.
5. Always consult with Environmental before planning for and handling raptor nests.

1. Install stinger cover onto cutout tap.

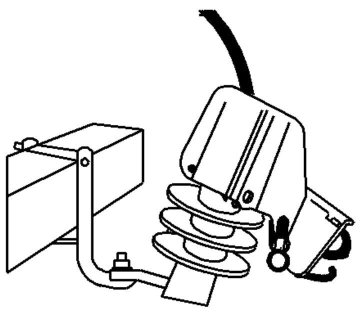
2. Use a shotgun hotstick - the holes in the top lip are designed to fit a shotgun. From the front of the cutout, guide the cover so the tap passes through the slit in the back as shown in this picture.



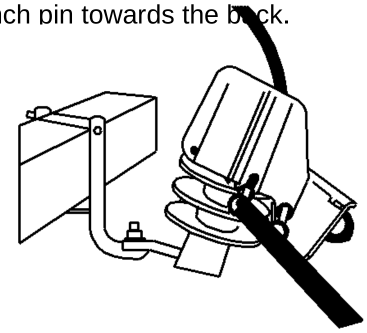
3. Now set the cover down on the cutout.



4. Install snap fit pins with a shotgun stick.



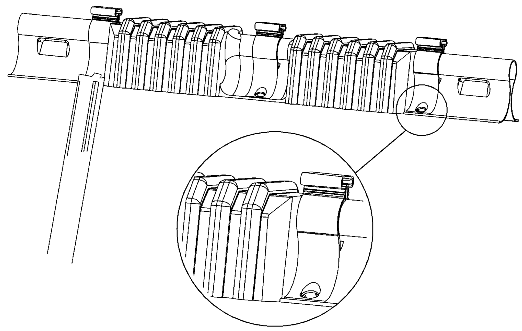
5. Finished installation. The 5.5-inch pin is installed towards the front of the cutout and the 3.5-inch pin towards the back.



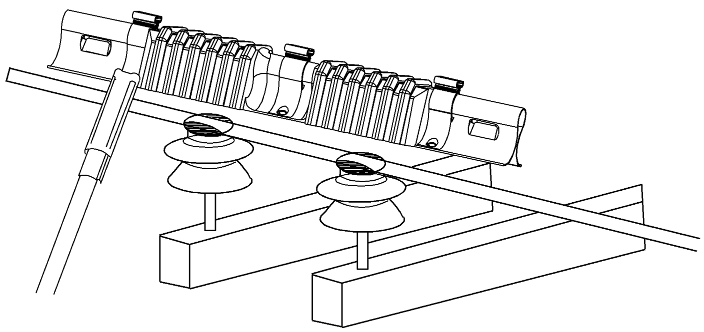
CU = CPWR32P	Cover

Cover Installation – STD Item T40

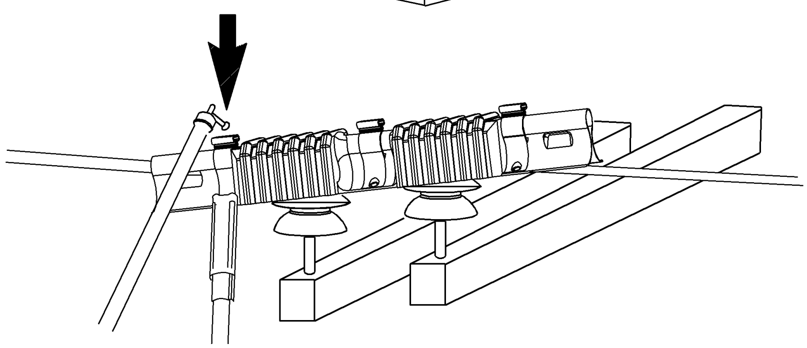
1. Secure cover to shotgun type hotstick through one of the four outside holes provided in the omega clip.



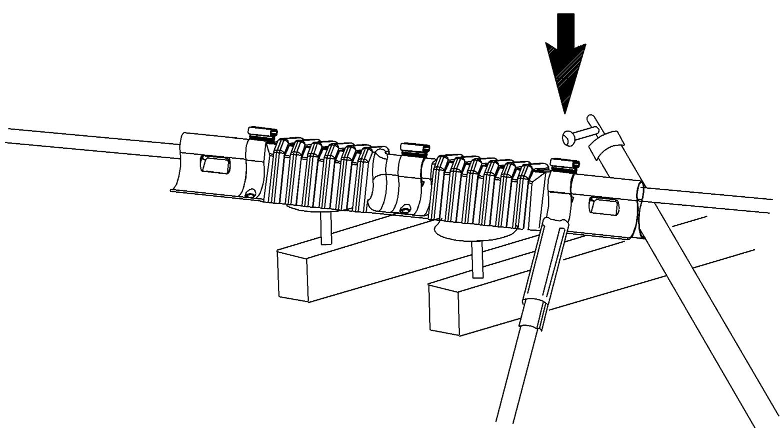
2. Drape the cover over the insulators and straddle the conductor.



3. Secure cover to conductor by taking a second hotstick and pushing down at the top of the clip. Disconnect hotsticks.



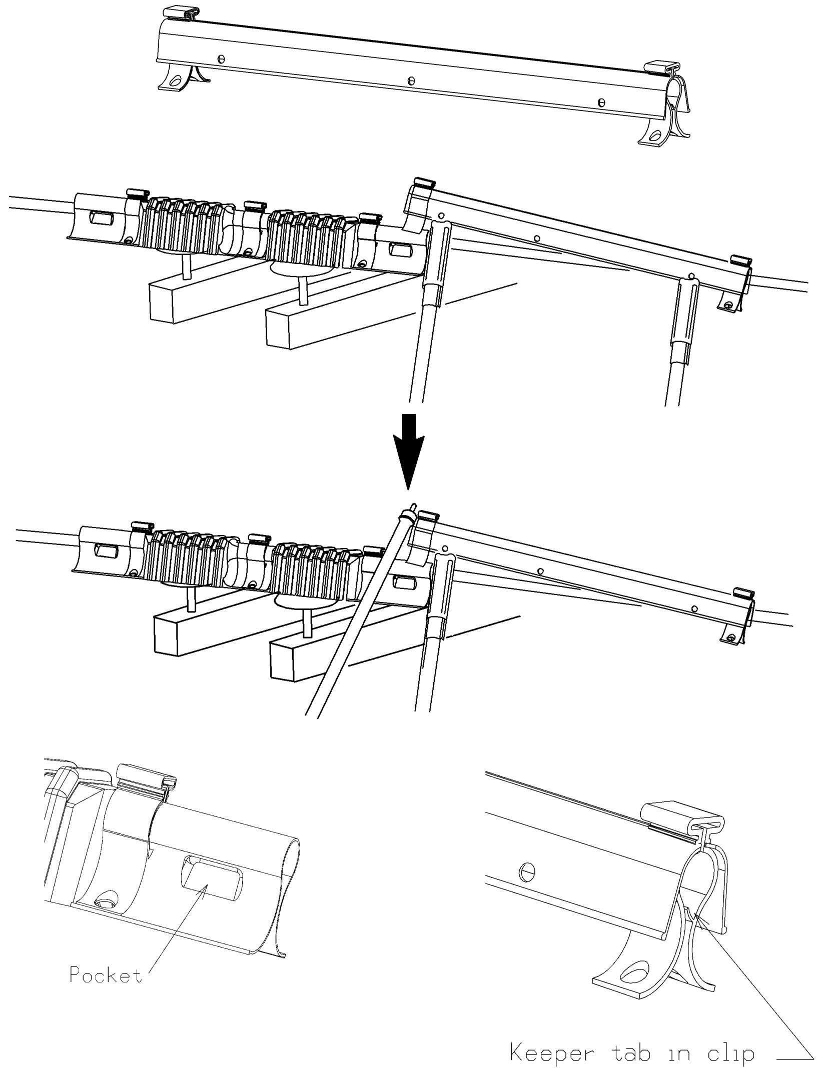
4. Secure hotstick to omega clip at opposite end of cover. Repeat step 3.



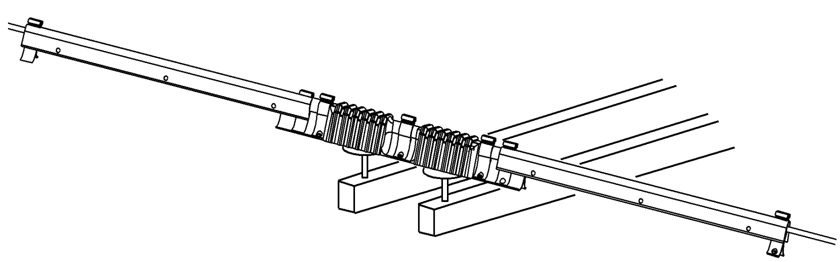
New Construction Drawing

Arm Installation – STD Item T43

5. Secure the hotsticks in the holes along the arm. Clip over and into the pockets on the cover by taking a second hotstick and pushing down at the top of the clip. Make sure “keeper” tab in clip sits into the pocket of the cover.



6. Installation complete.



New Construction Drawing

Version	Date	Modification	Author(s)	Approval by (Name/Title)
10	7/21	• Updated 2.1.30 Phase and Feeder Numbering • Revised 2.6 Pole Attachments • Removed Raptor from drawings 2-501 thru 2-504		
9	7/20	• Updated Index • Added 2.4.10 Contaminated Sites • Reformatted pages • Added reference to 2.9.60 on Drawing 2-106 • Added Drawings 2-301 & 2-301A		
8	7/19	• Added reference to H1 poles in 2.1. • Revised 2.1.30 Phase numbering. • Revised Drawing 2-106. • Revised Drawing 2-112. • Added Drawing 2-112A		
7	7/18	• Drawing 2-501. Corrected drawing title. • Drawing 2-501B. Dimensions modified.		
6	7/17	• Revised 2.10.10, Example 1, part 6. Overload factor of 1.26 from Table 4 incorrect. No overload factor required. • Corrected title error on pp 2-113.		
5	7/16	• Added 2.1.40 Warning Signs • Correct typo error in Example 1, step 3. • Added drawing 2-501B		
4	7/15	• Added self-supporting fiberglass composite poles 2-113. Revised section 2.8.40 and table of contents. • Corrected equipment weight typo for 45/H1 Cluster Mount 60”.		
3	7/14	• Expanded NESC Construction Grade definition 2.3.10 • Revised Example 1 in section 2.10.10 and added Example 2 and 3. • Added H1 pole class design strengths to Tables 3, 4 and 5. • Added H1 pole class to the ANSI 05.1 Table. • Added H1 pole class to the SYP and Douglas fir bending stress table. • Added H1 pole class to the pole weight table.		
2	7/11	• Added examples of when NESC Grade B Construction is needed. • Added figure showing fiberglass pole top extension to Drawing 2-106. • Minor editorial changes throughout the text portion of the section.		
1	07/08	• Under 2.1, changed page number & added MS2010. • Under 2.3 and 2.4, changed reference page number.		

		• Under 2.8.10, changed application requirement excluding spacer cable. • Under 2.8.30, added centermount information for fiberglass & changed 2.9.20 title. • Changed 2.9.30 title. • Added information on insulator examination & use in 2.9.50. • Added raptor protection paragraph (2.9.70). • Added fiberglass information to Table 3. • Changed Table 5 fiberglass note. • Added fiberglass information to page 2-102. • Updated CU numbers on page 2-105. • Changed company tag name on page 2-111. • Added animal guards and tag holders to drawing on page 2-112. • New construction drawings - pages 2-500 through 2-504.		

GENERAL

This section of the Standards is used to determine the appropriate guy/pole support necessary to support distribution poles and their equipment. The Standards in this section meet or exceed the requirements of the most recent publication of the National Electric Safety Code (NESC).

3.1 WHEN TO GUY

3.1.10 Deadend Poles

Poles at deadends, where an uneven number of wires terminate on each side of the pole, shall always be guyed. Where it is not practical to guy such a pole directly, the conductors may be deadended on the first or second pole from the end of that line. That pole shall be guyed and slack spans shall be strung to the terminal pole. The unbalanced force at the top of the unguyed pole shall in no case exceed 50% of the breaking strength of the pole.

3.1.20 Junction Poles

The junction pole with a lateral line deadend tap shall be guyed in the same manner as a 0deadend pole.

Supersedes 7/19 Issue – Updated Section 3.1.30

3.1.30 Transition Poles

Poles unbalanced more than 10% by a change in the number or size of conductors shall be longitudinally guyed (includes deadend in-line secondaries on tangent poles). Pole to pole guys to distribute the imbalance shall be considered. Review Section 6.5.30 if deadending with different size conductors.

3.1.40 Line Poles with Transverse (Lateral) Loading

Poles subject to excessive lateral loading shall be side guyed as required. These loadings include heavy unbalanced service pulls (e.g. when all services are taken off from one side of a line of poles); heavy transverse wind loading (e.g. long span north-south lines); and normally loaded pole lines set in soft soils. Transverse loading values for standard conductors are given in Section 6 (Primary Conductors). Transverse guying may also be required where poles are located in extremely hazardous locations.

3.1.50 Line Angle Poles

Poles at line angles where the steady unbalanced force due to conductor tension caused by the angle exceeds 300 lbs. (this includes 3 phase line poles at angles over 2 degrees and 1 phase line poles at angles over 4½ degrees) shall be guyed. Angles over 60 degrees require deadending the lines in both directions and guying both ways.

3.2 TYPES OF GUY WIRES/POLE SUPPORTS

3.2.10 Anchor/Down Guys

This is the most common type of guy wire used on distribution circuits. The lower end of the guy is anchored in the earth. This type of guy wire shall be installed in accordance with Drawing 3-105 or 3-106.

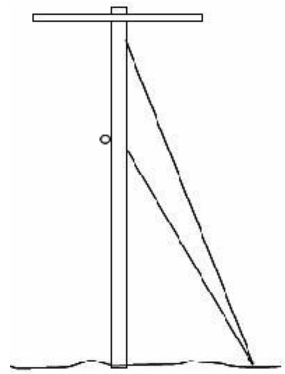


Figure 1 - Anchor/Down Guy

3.2.20 **<u>Stub Guys</u>**

When it is not feasible to guy directly to an anchor, a guy stub pole may be installed. When the guy stub pole is set where there is a possibility of a line being extended at a later date, the pole shall be of a length and class expected for such line extension. See Drawings 3-107D/3-107Y and 3-108D/3-108Y for installation details.

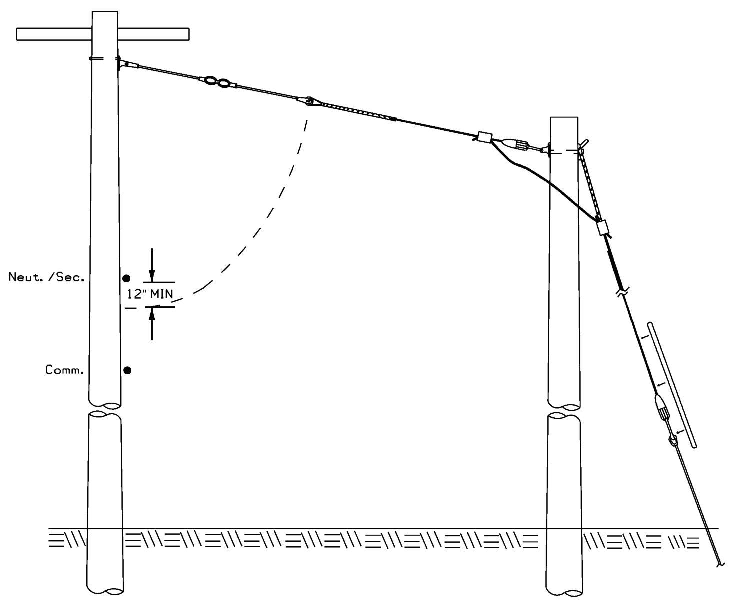


Figure 2 - Stub Guy

A. Steel Guy Stub Poles

Supersedes 1/06 Issue - Revised Section 3.2, added figures for each type of guy.

If additional strength is required for the stub pole, steel guy stub poles are available for use. The pole is manufactured in accordance with PPL MS2355 and is installed in accordance with Drawing 3-112.

3.2.30 Span Guys/Pole to Pole Guys

When it is not feasible to install an anchor guy directly on the pole, pole to pole guys may be installed to an adjacent pole. A minimum clearance of 15' 6" is required at the lower attachment point if the guy wire is above driveways, parking lots, alleys, and other land possibly traversed by vehicles that are more than 8' in height or by riders on horses or other large animals. If spaces and ways are subject to pedestrian or restricted traffic only (areas where riders on horses or other large animals, vehicles, or other mobile units exceeding a total height of 8' are prohibited by regulation or permanent terrain configurations), a minimum height of 9' 6" may be used (NESC Rule 232B, Table 232-1).. Refer to Drawing 3-115D/3-115Y for installation details.

Supersedes 7/10 Issue – Revised Section 3.2.30 on Figure 3.

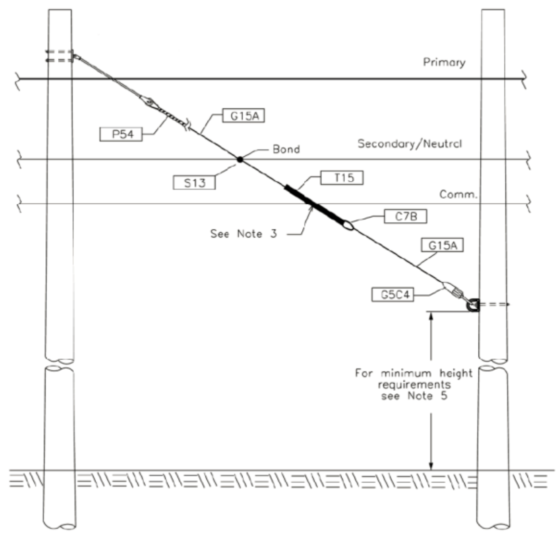


Figure 3 - Span Guy/Pole to Pole Guy

3.2.40 Sidewalk/Strut Guy

Where suitable land or access rights cannot be obtained for a sufficient guy lead length on an anchor guy, a sidewalk/strut guy shall be installed. Refer to Drawing 3-109D/3-109Y for installation details.

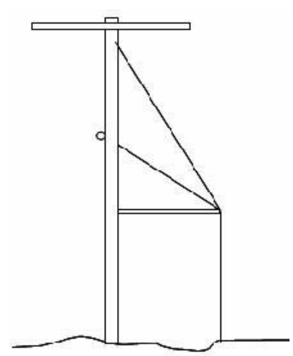


Figure 4 - Sidewalk/Strut Guy

3.2.50 Push Brace

Where the aforementioned means of guying a pole are not feasible, a push brace may be installed as shown on Drawing 3-111. For pole loading calculators, a push brace is treated as a regular down (anchor) guy installed on the opposite side of the pole. Refer to the table below for the minimum class pole that can be used for this installation.

Equiv. Amount of Guying	35 Foot Pole	40 Foot Pole	45 Foot Pole	Line Pole Setting to Balance Up-Lift
6M	5	5	4	Normal
12M 18M	5 4	4 3	3 2	Normal depth but backfill with crushed stone and earth well-tamped.
24M 30M	3 2	2 1	1 X	Set an extra foot deep; bolt with two 24" x 12" planks with two 5/8" bolts; backfill with crushed stone and earth well-tamped.
36M	1	X	X	Requires special considerations.

Table 1 - Minimum Class of Push Brace Pole Allowed

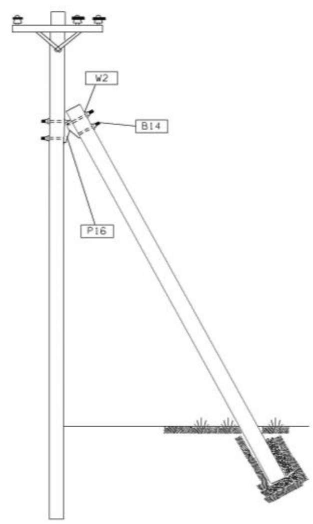


Figure 5 - Push Brace

3.2.60 Storm Guys

Pole lines located where topographical features may cause extreme winds (on ridgelines, for example) may require the installation of storm guys to offset the unbalanced condition created by these winds.

3.2.70 Unguyed Poles

Contact Distribution Standards Engineering or see Section 2 (Poles/Hardware) for requirements/alternatives for unguyed line angle poles. Slack span construction may be used where suitable land or guying rights cannot be obtained at line angle or deadend pole locations. Spans adjacent to the line angle should have approximately twice the normal sag. This added sag may limit span length in order to meet NESC midspan clearance requirements. Total pole loads shall be determined jointly with all telecommunication parties attached to the pole. Telecommunication conductors and equipment loading must also be considered when determining if guying may be omitted on angle poles.

Supersedes 1/06 Issue - Revised Section 3.2, added figures for each type of guy.

3.2.80 Steel Stub Pole

A steel guy stub pole is used when rights cannot be obtained or space is not available for conventional guying installations. The steel guy stub pole specification is in accordance with Material Specification MS 2355 and installed in accordance with Page 3-112. The maximum horizontal load per attachment point is 13,400 lbs. The maximum combined horizontal load on the pole stub on both attachment points is 24,000 lbs. (21,600 lbs with .9 overload factor per NESC). For a guy at an angle ( ) other that horizontal (See Page 3-112), the equivalent horizontal tension per attachment point is determined by the formula T x Cosine . This value shall not be greater that 13,400 lbs. T equals the tension on the guy and equals the angle of the guy from horizontal. Example: For a guy with a design tension of 15,000 lbs. at an angle of 30 degrees, 15,000 x Cosine 30 degrees = 15,000 x .866 = 12,990 lbs. Since this load does not exceed the maximum horizontal load of 13,400 lbs for an attachment point, this load is acceptable. Note: Two guys with this load would exceed the maximum allowable horizontal load on this stub (13,400 lbs x 2 = 26,800 lbs., which is greater than the allowed maximum combined horizontal load of 21,600 lbs).

Added 3.2.80 Steel Stub Pole design guide.

3.3 GUYING MATERIALS

3.3.10 Guy Wire

There are currently two sizes of guy wire available for new construction, but the table below also includes some of the common sizes that were previously used on the system in case there is equipment being added to an existing guyed pole.

Std Item #	Size	RBS (Rated Breaking Strength)	Use Strength (90% of the RBS)
G11 (old)	1/4" galvanized steel (3M)	3150 lbs	2800 lbs
G13A (old)	5/16" galvanized steel (6M)	6000 lbs	5400 lbs
G15A (old)	3/8" galvanized steel (10M)	11500 lbs	10350 lbs
G15A	**3/8" alumoweld (12.5M)**	**12630 lbs**	**11367 lbs**
(old)	11/32" (13M)	12630 lbs	11367 lbs
G17A	**7/16" galvanized steel (16M)**	**18000 lbs**	**16200 lbs**
G17B	7/16" copperweld (16M)	16890 lbs	15200 lbs

Table 2 - Guy Wire Sizes and Strengths

Items G15A and G17A are the two sizes of guy wire currently used for new construction on distribution circuits. Item G17B is commonly used for guy wire on sub-transmission/distribution supply circuits or it is used as a messenger wire in some situations. The other sizes listed are not available but are listed for reference purposes.

3.3.20 Anchor Rod and Helix

Anchor selection is based primarily upon actual field soil conditions. A standard 10 inch screw anchor (Std Item A16A) shall be used unless soil conditions are known to be unsuitable for the required holding capacity or the anchor location is inaccessible to a digger truck. Installation of or failure to install the standard 10 inch screw anchor will provide the best basis for determining whether a different anchor is needed. A 14 inch screw anchor (Std Item A16B) shall be used in lower class soil conditions (see the following table and Drawing 3-102). Maximum soil/anchor holding strength should be sought since this will likely be the weakest link of the guy-anchor assembly. If a screw anchor cannot be installed because it is inaccessible to a digger truck, a hand dug anchor can be used. See Drawing 3-104.

Usually knowledge of the soil types encountered on site will help promote proper anchor selection. Observation of the soil removed from the pole bore hole is the best practical methods for judging the site soil type. The following table should be used as a general guide for determining soil type and anchor selection.

Soil Class	Soil Description	Recommended Anchor
0	Sound unweathered rock	A13A - Rock Anchor 
1	Very dense and/or cemented sands, coarse gravel and cobbles	A16C - Twin 4" Helix 
2	Dense sand, very hard silts & clay, coarse gravel	A16A - 10" Helix 
3	Dense sands & clay, hard silts & clay, gravel, shale, hardpan, broken rock	
4	Compacted sands, gravel, claypan, hard silts & clays	
5	Compacted coarse sand, sandy gravels, still silts & clay	
6	Loose coarse sand, firm clay loam, damp clay	A16B - 14" Helix 
7*	Loose fine sand, varied clays, silt loam, fill	
8*	Swamp, saturated loam, marshland, peat	

Table 3 - Soil Classes and Recommended Anchors

Notes:
*** -** Anchor should penetrate through saturated strata to class 5, 6, or 7 substrata for best results.
- Anchor selection as shown is for general use. Best judgement may be used to decide between Class 1 and 2 (twin 4" or single 10"), and Class 5 and 6 (single 10" or single 14").
- Actual anchor holding capacity will depend on the real holding capacity of the soil. General soil holding capacities, provided by the anchor manufacturers, are reduced to NESC required 90% and are shown in the following table.

STANDARD SCREW ANCHOR	APPROXIMATE EXPECTED SOIL HOLDING CAPACITY – IN LBS X 90% FOR STANDARD SCREW ANCHORS INSTALLED IN THESE SOIL CLASS TYPES						
	DENSE/ROCKY SOILS……………………………….LOOSE/SOFT SOILS						
	CLASS 1	CLASS 2	CLASS 3	CLASS 4	CLASS 5	CLASS 6	CLASS 7
Twin 4" HELIX (for Hard Soils) (A16C)	32,000	27,000	16,000				
Single 10" HELIX (all Normal Soils) (A16A)	32,000	25,200	21,600	18,000	14,000	10,000	8,000
Single 14" HELIX (for Soft Soils) (A16B)				28,000	22,000	19,000	15,000

Table 4 - Approximate Holding Capacity for Anchors

Note: Soil holding strength is an important component of the guy-anchor system. These holding capacity values were derived from field testing results obtained by the manufacturers. The installing torque required during installation is proportional to the resulting holding strength of the system. The skill and experience of the operator is generally the best or only indicator of a sound anchor installation.

Supersedes 1/06 Issue - Information on this page was previously found in Section 3.5.20.

Supersedes 7/10 Issue – Eliminated Guy Hook TG10 and added additional guy hook details.

3.3.30 Bolts

Two bolts sizes are used for guying – a 5/8" and a 3/4". The lengths will vary depending on the diameter of the pole, what all it is holding, etc. Refer to the table below for rated strength and use strength for each type of bolt used for guying.

Std Item	Description	Minimum Tensile Strength	Use Strength (90% of Min Tensile Strength) per NESC
B13_	5/8" square head machine bolt	12,400 lbs	11,000 lbs
B14_	3/4" square head machine bolt	18,350 lbs	16,500 lbs

Table 5 - Thru-Bolt Strengths

3.3.40 Guy Hooks

Guy hooks are selected based on strength needed and angle at which the guy will be installed. The B20A or B20B items are used for span, pole or the seldom used arm guys where the pull is very close to horizontal. TG17 is used on fiberglass poles. A detailed installation drawing can be found in Section 9 for TG17.

Guy Hooks			
Item	**Bolt Size**	**Use Strength**	**Remarks**
B20A	1-5/8"	11,000 lbs	Meets/ exceeds use rating of bolts
B20B	1-3/4"	16,500 lbs	
G33A	1-5/8"	11,000 lbs	
G33B[Y]	2-3/4"	16,500 lbs	
G33C[E]	1-3/4"	25,000 lbs	
G33D[E]	1-3/4"	25,000 lbs	
TG13*****	2-3/4"	20,000 lbs	
TG14******	2-3/4"	28,000 lbs	
TG15[E]	2-3/4"	30,000 lbs	
TG17	3-5/8"		Use with 12.5M guy wire only

Table 6 - Guy Hooks and Rated Strengths

***TG13:** For a single 16M down guy wire, use with one ¾" thru-bolt, a 3" square curved washer, and two lag screws.
For 12.5M pole to pole/span guys and stub pole guys, use with two ¾" thru-bolts and two 3" square curved washers.

****TG14**: For a dual 12.5M down guy wire, use with one ¾" thru-bolt, one 3" square curved washer, and two lag screws.
For dual 12.5M pole to pole/span guys and stub pole guys, use with two ¾" thru-bolts and two 3" square curved washers.

3.3.50 Guy Grips

Guy grips/connectors, both preformed (Std Item P54) and automatic (Std Item G5C), are full-tension devices, based on the heaviest strand for which they were designed and rated for over 95% of the conductor rated breaking strength. The preforms can be located at any attachment point – at the top by the guy hook, at the bottom by the anchor, or in the middle at insulators. The automatic guy grip is used at the anchor only (shall not be used at the top of the guy). For areas where automatics rust and break due to salt or other contaminants, refer to Section 8 - Coastline Construction.

3.3.60 Fiberglass Guy Strain Insulators

Guy strain insulators are to be installed in distribution guys to maintain the basic insulation impulse level (BIL) of the pole top, to provide and maintain the required clearances from equipment as specified by the NESC, and to provide additional worker safety. Refer to the following table for installation guidelines.

Std Item #	Size	Rated Breaking Strength	Use Strength (90% of the RBS) per NESC
I24	12” fiberglass rod	15,000 lbs	13,500 lbs
TI95B	54” fiberglass rod	15,000 lbs	13,500 lbs
TI95C	54” fiberglass rod	30,000 lbs	27,000 lbs
TI95D	72” fiberglass rod	30,000 lbs	27,000 lbs
TI95E	120” fiberglass rod	30,000 lbs	27,000 lbs

Table 7 - Fiberglass Guy Strain Insulators

For more information on placement of fiberglass insulators in the guy wires, refer to Section 3.4 below.

Note: Ceramic guy insulators (“Johnny Balls”) are no longer approved for use on new guy wire construction.

3.4 BONDING AND ISOLATION/INSULATION

The NESC requires that all guy wire shall be effectively grounded or insulated.

3.4.10 Effectively Grounded or Multi-Grounded Wye Circuits

A. Primary Guy Wires

All primary guy wires shall have a fiberglass insulating rod (54” minimum length) at the top (pole end) of the guy. The guy wire shall also be bonded to the system neutral using a compression connector **except** where the bond wire will create a work method problem. If the exception is taken, the guy wire shall be insulated/isolated as described below for guy wires on delta circuits. See Drawings 3-105 and 3-106 for more details.

B. Secondary Guy Wires

All secondary guy wires shall be attached at the lowest secondary attachment point (usually the secondary cable). All secondary guy wires on an effectively grounded or multi-grounded wye circuit shall be bonded to the system neutral using a compression connector. See Drawing 3-118 for more details.

3.4.20 Delta or Uni-Grounded Circuits

A. Primary Guy Wires

All primary guy wires shall have a minimum of two 54” fiberglass insulating rods at the top (pole end) of the guy. There shall be a minimum of 12” of fiberglass from the bottom insulator that extends past the secondary connection to prevent the transfer of energy from electric conductors to any third party attachments if the guy were slack against the pole. It is acceptable to use a combination of fiberglass rods to obtain the 12” of fiberglass below the secondary connection. See Drawing 3-105 and 3-106 for more details.

B. Secondary Guy Wires

All secondary guy wires shall be attached at the lowest secondary attachment point (usually the secondary cable). All secondary guy wires on delta or uni-grounded circuits shall be insulated with a minimum of one fiberglass insulating rod (12” minimum length). See Drawing 3-119 for more details.

Supersedes 7-10 Issue –Added TI95E 120” fiberglass rod.

Supersedes 7/10 Issue - Added multi-circuit guying guidelines.

3.4.30 Stub Guy Poles

Refer to Drawings 3-107W and 3-107D for construction details when there is no secondary on the stub pole. Refer to Drawings 3-108W and 3-108D when there is secondary on the stub pole.

3.4.40 Ceramic/Porcelain Insulators (Johnny Balls)

This type of guy insulator is no longer accepted for use on new construction. Ceramic/porcelain insulators can either be removed from the guy wire or a jumper wire can be placed across the insulator when the guy wire is being brought up to current Standards (i.e. during a conversion, structure replacement, or when reconductoring a line).

3.4.50 Voltage Conversions

When performing circuit voltage conversions, if the guy wires are properly built to current Standards for the existing type of circuit (delta or wye), there is no requirement to change the guy wires after the conversion is complete.

A. **EXAMPLES**

1. Converting a 5kV class delta circuit to a 15kV class wye circuit:
   - Build guy wires to current Standards for guy wires on a 15kV class delta circuit.
   - This includes removing existing ceramic/porcelain guy insulators (commonly referred to as “Johnny balls”) or installing a jumper wire across it as these are no longer used for guy wire insulation and installing required fiberglass guy insulators.
   - It is not necessary to go back and bond the guy wires or jumper out the guy insulators as part of the conversion project.

2. Converting a 5kV class wye circuit to a 15kV class wye circuit:
   - Build guy wires to current Standards for guy wires on a 15kV class wye circuit.
   - This includes installing the 54” fiberglass at the top of primary guy wires where not already installed and/or removing existing ceramic/porcelain guy insulators (commonly referred to as “Johnny balls”) or installing a jumper wire across it as these are no longer used for guy wire insulation and installing required fiberglass guy insulators.
   - This includes bonding all guy wires to the system neutral where not already bonded.

3.4.60 Guying on Multi-Circuit Structures

On structures where at least one ungrounded/delta circuit is present, the guying standards in Section 3.4.20 (Delta or Uni-Grounded Circuits) shall be followed.

On structures where all circuits are multi-grounded wye, the guying standards in Section 3.4.10 (Effectively Grounded or Multi-Grounded Wye Circuits) shall be followed since all neutrals on these structures will be bonded together.

3.5 CLEARANCES

When installing guy wires, adequate clearance shall be maintained between all conductors and guy wires and guy strain insulators per NESC Table 235-6 and Note 11. Minimum clearance depends upon the type of guy wire installed and the normal operating voltage. Additional clearance may be required due to conductor movement as a result of wind. Refer to the following tables for required clearances.

Clearance between the primary conductor and fiberglass guy strain insulator may be reduced by no more than 25% of the clearance between the primary conductor and guy wire. This reduced clearance is shown in the following tables.

3.5.10 Down/Sidewalk Guys

Primary Voltage (Phase to Phase)	Clearance - Primary to Guy Wire	Clearance - Primary to Guy Insulator
Up to 8.7kV	6”	5”
>8.7kV to 15kV	8”	6”
>15kV to 25kV	11”	9”
>25kV to 35kV	13”	10”
>35kV to 50kV	17”	13”

Table 8 - Down/Sidewalk Guy Clearances

3.5.20 Span Guys

Primary Voltage (Phase to Phase)	Clearance - Primary to Guy Wire	Clearance - Primary to Guy Insulator
Up to 8.7kV	12”	9”
>8.7kV to 15kV	15”	11”
>15kV to 25kV	19”	15”
>25kV to 35kV	23”	17”
>35kV to 50kV	29”	22”

Table 9 - Span Guy Clearances

3.5.30 Other Guys

These guy wires are defined as a guy wire that is neither a down guy nor a span guy, but a guy wire that is attached to two distribution poles that do not have conductors parallel to the guy wire (a stub pole guy, for example).

Primary Voltage (Phase to Phase)	Clearance - Primary to Guy Wire	Clearance - Primary to Guy Insulator
Up to 8.7kV	6”	5”
>8.7kV to 15kV	7”	6”
>15kV to 25kV	13”	10”
>25kV to 35kV	17”	13”
>35kV to 50kV	23”	18”

Table 10 - Other Guy Wire Clearances

3.5.40 Other Clearance Considerations

The same clearances apply for double circuit construction; however additional fiberglass rods may be needed to prevent contact with the lower primary if the guy wire were to break (see Figure 6~~Figure 6~~ below).

Supersedes 7/10 Issue - Text shifted.

Supersedes 7/10 Issue - Edited Figure 6 and Figure 7.

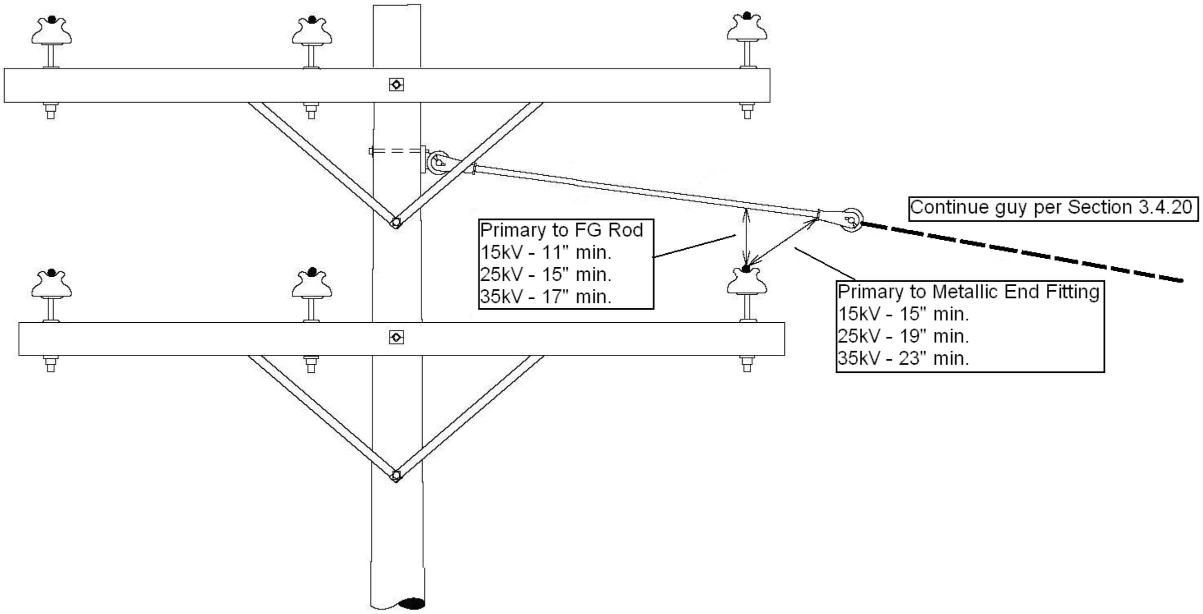


Figure 6 - Double Circuit Guy Wire (Using Table 9 Clearances)

For poles that also have a transformer on it, clearance needs to be maintained between the guy wire and bushings (see Figure 7~~Figure 7~~ below).

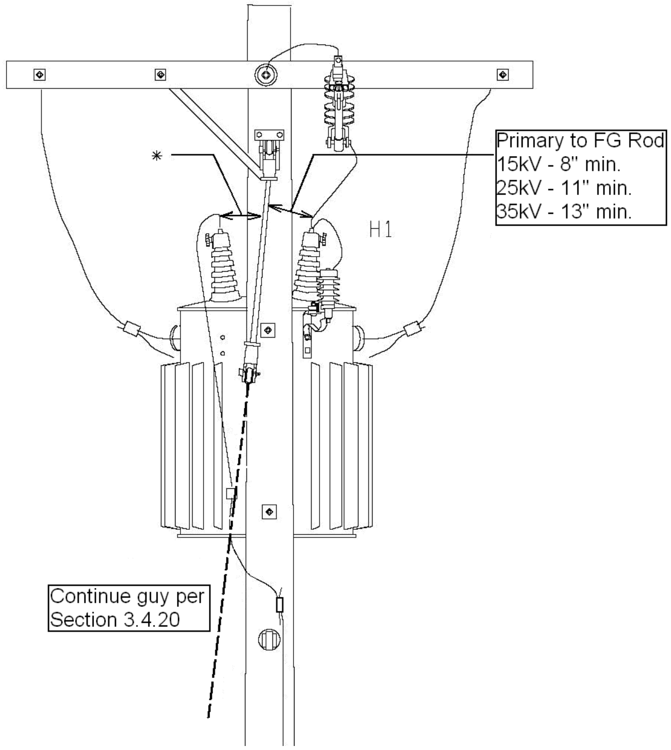


Figure 7 - Guy Wire Clearances (Using Table 8 Clearances)

If a pole-to-pole guy (span guy) is attached above the primary conductors, additional clearance may be needed towards the middle of the span where there can be conductor movement due to wind. In the example below in Figure 8~~Figure 8~~, spacer cable messenger is deadended on one side of the pole at the top of the figure, and there is a guy wire attached on the other side of the pole above the primary conductors.

Where the guy wire passes by a conductor, adequate clearance must be maintained between the conductor and guy wire and/or guy insulator. If the conductor to guy wire/insulator clearance point is near the pole attachment, the clearances from Table 9~~Table 9~~ are required. If the clearance to the guy/insulator clearance point is further than a few feet from the guy attachment point to the pole, additional clearance is required to take into account conductor movement due to wind. Refer to Section 6 to calculate the maximum conductor horizontal movement using the conductor swing angle.

For this type of installation, do not install the middle phase of the primary conductors directly above the guy wire (do not use a pole top pin). Install the middle phase on the crossarms, as shown.

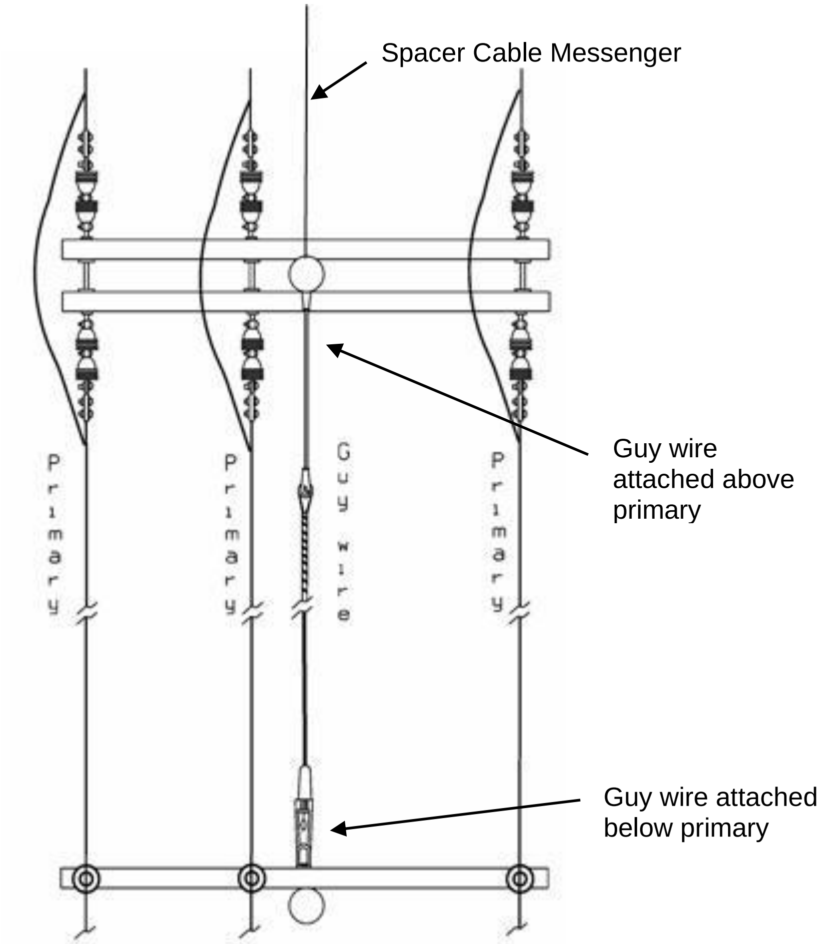


Figure 8 - Span Guy Clearance Considerations - Top View

Supersedes 7/10 Issue - Text shifted.

3.5.50 <u>Guy Wire Clearance to Neutrals</u>

The NESC requires 6” of clearance between the guy wire and the neutral. By using a fiberglass rod the distance between the conductor (neutral) and the fiberglass rod can be reduced by 25%. Therefore, the clearance between the fiberglass rod and the neutral shall be no less than 5”.

3.5.60 <u>Guy Wire Clearance to Third Party Conductors</u>

Per NESC, 6” of clearance is required between the guy wire and communication cables. This clearance may be reduced to no less than 3” if abrasion protection (Std Item T15) is added to the guy wire. See Drawing 3-115D/3-115Y for installation details.

7/18 New Issue.

3.5.70 Existing Insulated Guy Wire Configuration Guide

The following Figure 8A provides a quick reference design guidance when additional communication or electric facilities (such as conductors, wires, cables, cabinets, or active devices) are being added on an existing pole. The latest edition (2017) of the National Electric Safety Code (NESC) requires that anchor guy wires be grounded (effectively grounded wye systems) or properly insulated to limit the likelihood of any portion of an anchor guy becoming energized within 8 feet of the ground level in the event that the anchor guy becomes slack or broken. Though no longer required by the NESC, PPL continues to require that new installations of insulated anchor guys limit the likelihood of an anchor guy becoming a conductive path between an energized conductor or part and a conductor of another circuit in the event that the anchor guy becomes slack or broken.

New poles and any associated guy wires shall be built to current PPL construction standards.

Definitions

Anchor guy meets NESC – *The guy wire is grounded (effectively grounded wye systems) or insulated to limit the likelihood of any portion of an anchor guy becoming energized within 8 feet of the ground level in the event that the anchor guy becomes slack or broken.1*

Anchor guy meets PPL standards – *The guy wire is grounded (effectively grounded wye systems) or insulated to limit the likelihood of an anchor guy becoming a conductive path between an energized conductor or part and a conductor of another circuit in the event that the anchor guy becomes slack or broken.1*

Requirements for Adding Facilities to Existing Poles with Anchor Guy Wires
When additional communication or electric facilities (such as conductors, wires, cables, cabinets, or active devices) are being added on an existing pole, the actions required specific to anchor guy wires based on existing conditions are identified below:

Field Condition prior to adding facilities:

Existing anchor guy meets PPL standards –

- If the existing anchor guy is properly grounded or insulated per PPL standards after the addition of new facilities on the pole, no modifications to the anchor guy is required to allow the new facilities on the pole.
- If the existing anchor guy will not meet PPL standards after the addition of new facilities on the pole, the anchor guy must be modified or replaced per PPL standards before the new facilities are added on the pole.

Existing anchor guy does not meet PPL standards –

- If the existing anchor guy is properly grounded or insulated per NESC requirements after the addition of new facilities on the pole, no modifications to the anchor guy is required to allow the new facilities on the pole.
- If the existing anchor guy will not meet the NESC requirements after the addition of new facilities on the pole, the anchor guy must be modified to meet the NESC or may need to be replaced per PPL standards before the new facilities are added on the pole.

Note - Fiberglass guy strain insulators or porcelain (“johnny ball”) guy insulators are acceptable insulating materials for existing guy wires. In effectively grounded wye systems exceeding 12kV phase-to-ground or in non-effectively grounded or delta systems exceeding 12kV phase-to-phase voltage, a single johnny ball insulator in guys may not be adequate. Contact Standards Engineering for additional information about the use of johnny ball insulators in guys for these systems.

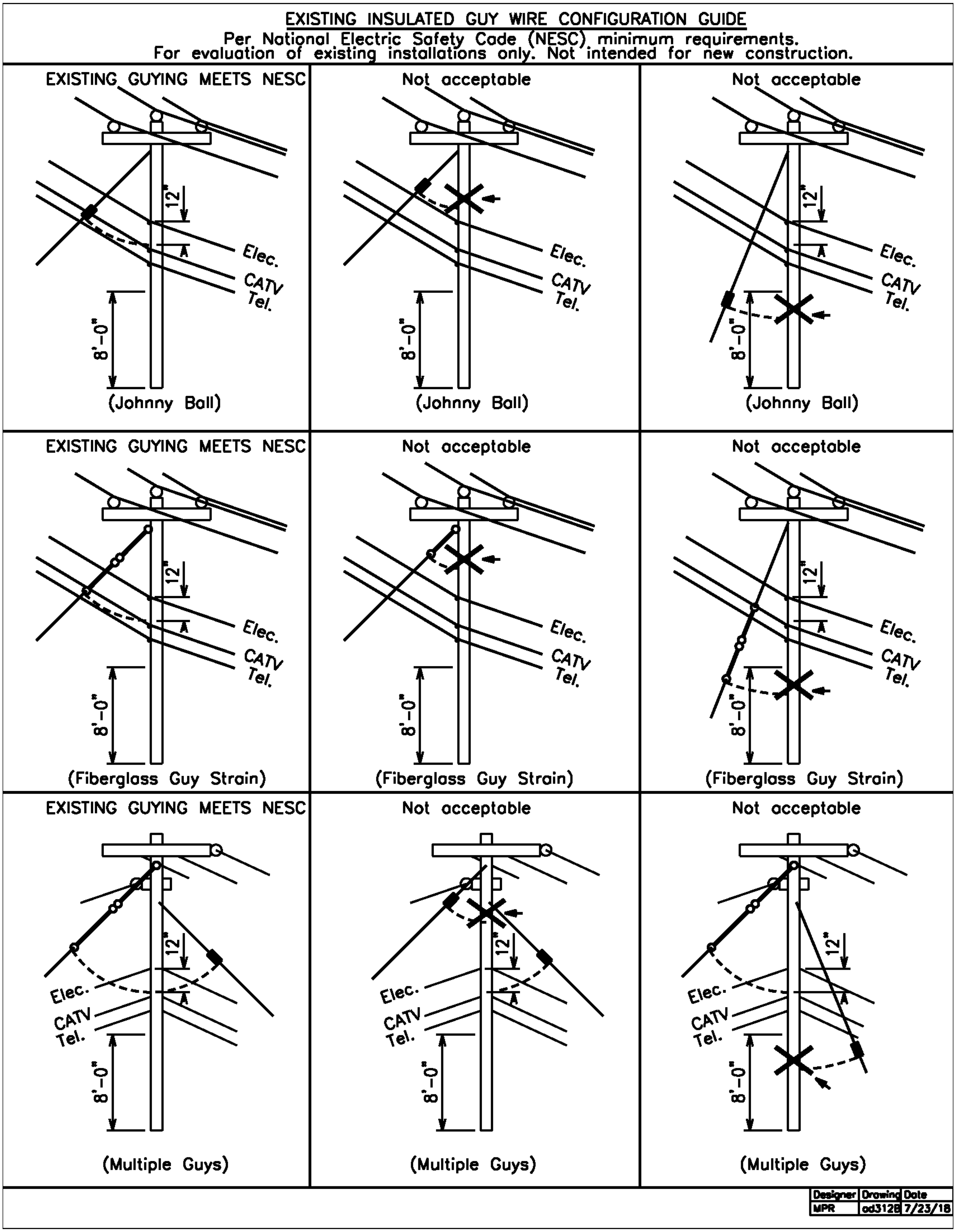


Figure 8A – Existing Insulated Guy Wire Configuration Guide

Supersedes 7/10 Issue - Changed material used for abrasion protection in 3.5.60.

3.6 DETERMINING THE STRENGTH REQUIRED TO SUPPORT THE POLE

3.6.10 General

The amount of guy strength required to prevent a pole from leaning or falling over depends on the storm loaded tension of the conductors, the line angle (pull or corner) on the pole, and the length of the lead away from the pole (lead/height ratio).

Wherever possible, guying layout should be preformed in the field before construction begins so that obstacles to the desired guying can be taken into consideration. All pole and guy locations should be staked or otherwise marked to assure adequate lead lengths and proper locations.

Guys should be installed as close to the unbalanced load as possible. Guy anchor assemblies shall be designed for the sum of all loads placed upon them. The unbalanced force above the top guy shall be less than 50% of the resisting moment of the pole at the point of guy attachment.

If there are other loads of similar magnitude below the top guy, they should be balanced with a second guy. Deadended secondaries limited to a 2,000 lb design may be installed without an additional guy unless the magnitude of the total loading (primary and secondary) dictates the use of more than one guy. All communication conductors and messengers shall be guyed by the Owner of the telecommunication facilities against their unbalanced loads where required.

Design of the guy assembly shall include the following NESC overload factors for Grade C and B construction.

TYPE OF LOAD	NESC TABLE 253-1 OVERLOAD CAPACITY FACTOR	
	Grade C	Grade B
Vertical Loads	1.90	1.50
Transverse Loads: Wind	1.75	2.50
Transverse Loads: Wire Tension	1.10	1.65
Longitudinal Loads: In General	None	1.10
Longitudinal Loads: At Deadends	1.10	1.65

Table 11 - NESC Overload Factors for Guy Wires

Construction Component	Grade C	Grade B
Poles	0.85	0.65
Guy Wire	0.9	0.9
Anchors and Foundations	1.0	1.0

Table 12 - Strength Factors for Poles, Guys and Anchors (per NESC)

3.6.20 Procedure

Determine the pull or corner on the pole if applicable. The following diagrams illustrate methods of determining pull on the pole (in feet) by direct measurement. When measuring pull, if D is 100 feet, then P is the pull (also in feet). If D is other than 100 feet, the pull would be (100/D)*P

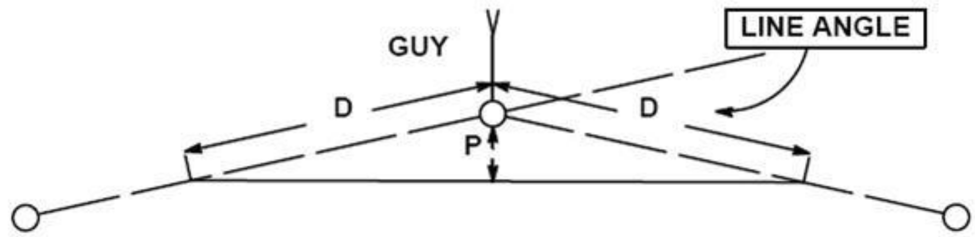


Figure 9 - Preferred Method of Finding Pull

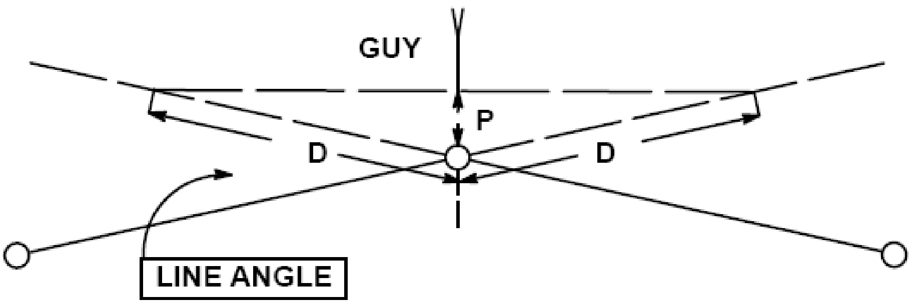


Figure 10 - Alternate Method #1 of Finding Pull

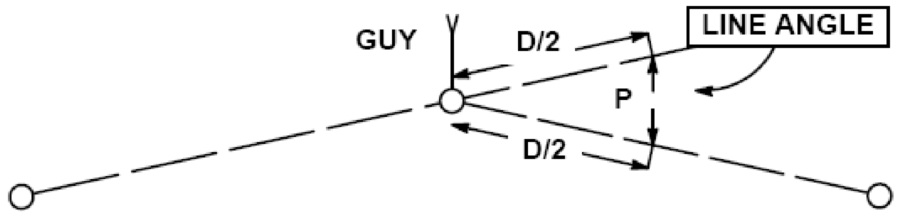


Figure 11 - Alternate Method #2 of Finding Pull

New page. Info was previously found on Page 3-75.

Line Angle (degrees)	Pull (feet)	Line Angle Factor	Line Angle (degrees)	Pull (feet)	Line Angle Factor
1	0.9	0.0175	31	26.7	0.5150
2	1.7	0.0349	32	27.6	0.5299
3	2.6	0.0524	33	28.4	0.5446
4	3.5	0.0698	34	29.2	0.5592
5	4.4	0.0872	35	30.1	0.5736
6	5.2	0.1045	36	30.9	0.5878
7	6.1	0.1219	37	31.7	0.6018
8	7.0	0.1392	38	32.6	0.6157
9	7.8	0.1564	39	33.4	0.6293
10	8.7	0.1736	40	34.2	0.6428
11	9.6	0.1908	41	35.0	0.6561
12	10.5	0.2079	42	35.8	0.6691
13	11.3	0.2250	43	36.7	0.6820
14	12.2	0.2419	44	37.5	0.6947
15	13.1	0.2588	45	38.3	0.7071
16	13.9	0.2756	46	39.1	0.7193
17	14.8	0.2924	47	39.9	0.7314
18	15.6	0.3090	48	40.7	0.7431
19	16.5	0.3256	49	41.5	0.7547
20	17.4	0.3420	50	42.3	0.7660
21	18.2	0.3584	51	43.1	0.7771
22	19.1	0.3746	52	43.8	0.7880
23	19.9	0.3907	53	44.6	0.7986
24	20.8	0.4067	54	45.4	0.8090
25	21.6	0.4226	55	46.2	0.8192
26	22.5	0.4384	56	46.9	0.8290
27	23.3	0.4540	57	47.7	0.8387
28	24.2	0.4695	58	48.5	0.8480
29	25.0	0.4848	59	49.2	0.8572
30	25.9	0.5000	60	50.0	0.8660

Line Angle Factor = Sine (Line Angle in Degrees)

Table 13 - Line Angle Factors

Refer to the following figure when measuring the lead to height ratio of a guy.

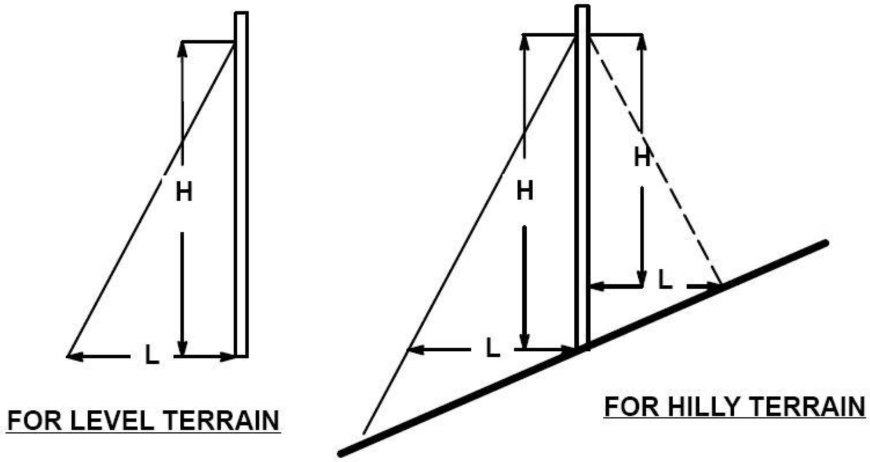


Figure 12 - Measuring Lead and Height

When the terrain slopes and the guy will be installed higher or lower than the base of the pole, adjustments must be made to the lead and height measurements. **Note: The Lead/Height ratio shall never be less than 0.3 because guy loading on the pole becomes excessive.**

The following “Quick Calculations” can be used for most guying calculations. For more detailed calculations and examples, refer to Section 3.7 (Worksheets and Examples).

A. Quick Calculation - Line Angles

1. Find the total conductor and equipment (if applicable) tension by multiplying the number of wires by the storm loaded tension of each wire and adding equipment loading information found in Table 15~~Table 15~~. Storm loaded tensions can be found in Section 6.
2. Multiply the total loaded tension by the NESC safety factor required (see Table 11~~Table 11~~).
3. Using Figure 13~~Figure 13~~ on the following page, locate this total loaded tension on the “A” scale.
4. Follow the line diagonally up to where it intersects Line Angle.
5. Follow this point horizontally to the right of the “B” scale, which gives you the resultant horizontal loading.
6. Continue that point horizontally to the right where it intersects the L/H ratio line.
7. Follow the arc down from this point to the “C” scale - which is the guy tension.
8. Use the result to determine the proper materials needed.

B. Quick Calculation - Deadends

1. Find the total conductor and equipment (if applicable) tension by multiplying the number of wires by the storm loaded tension of each wire and adding equipment loading information found in Table 15~~Table 15~~. Storm loaded tensions can be found in Section 6.
2. Multiply the total loaded tension by the NESC safety factor required (see Table 11~~Table 11~~).
3. Using Figure 13~~Figure 13~~ on the following page, locate this tension on the “B” scale.
4. Follow this point to the right where it intersects with the L/H ratio line.
5. Follow the arc down from this point to the “C” scale - which is the guy tension.
6. Use the result to determine the proper materials needed.

New page. Figure on this page was previously found on Page 3-101. Quick calculations added.

New page with new figure for quick calculations.

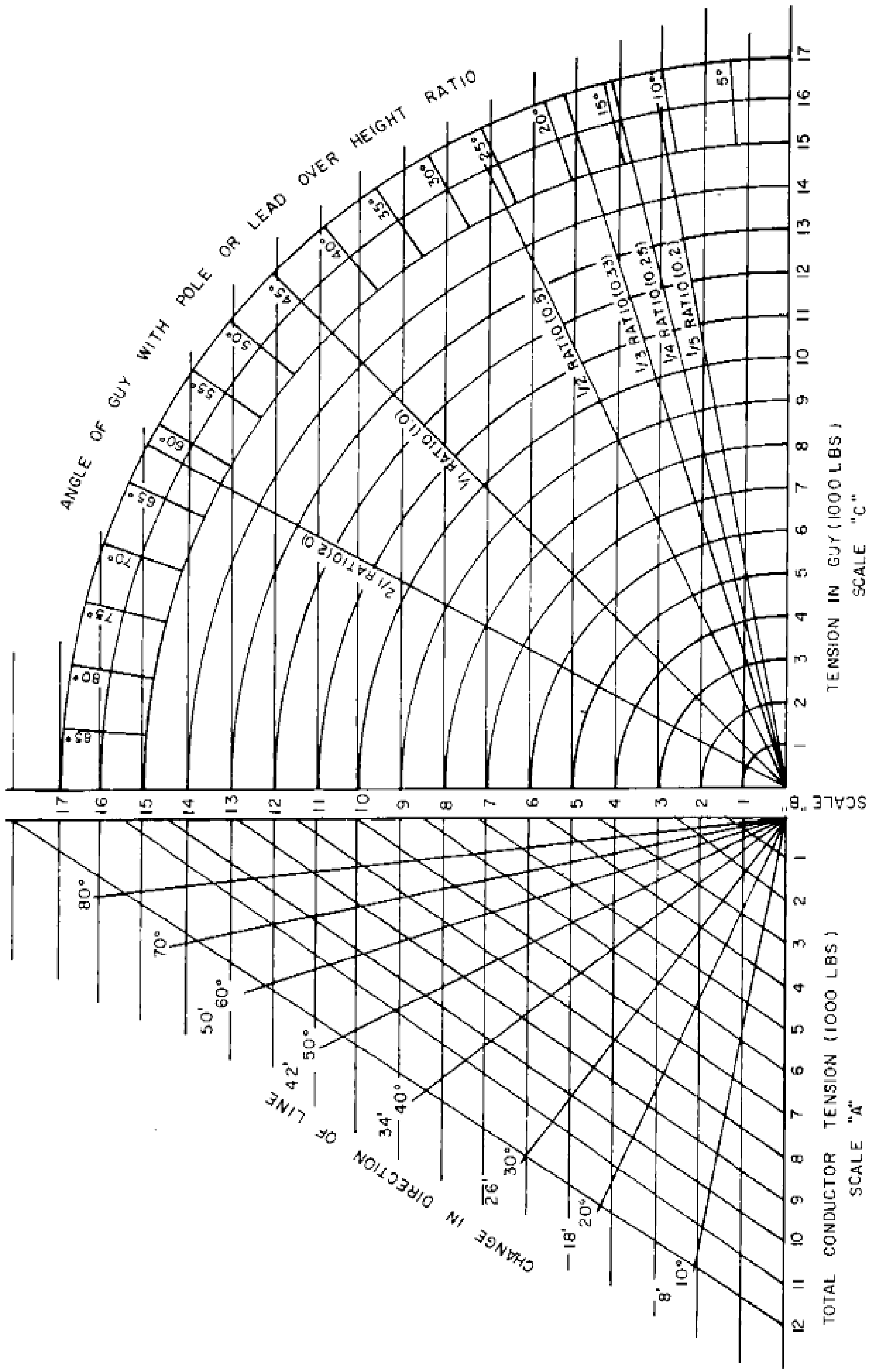


Figure 13 - Guy Wire Chart

3.6.30 Tables Needed for Calculations

Refer to the following tables for calculating guy wire loading.

Description		Conductor Size Diameter (in.)	Conductor Tension (lbs.)	Transverse Load Factor (lbs./ft.)
#22 AWG and 3/8" Messenger	25 Pair	1.000	6,600	0.667
	50 Pair	1.175	6,600	0.725
	100 Pair	1.445	6,600	0.815
	200 Pair	1.815	6,600	0.938
	300 Pair	2.115	6,600	1.038
	400 Pair	2.345	6,600	1.115
#24 AWG and 3/8" Messenger	600 Pair	2.295	6,600	1.098
	900 Pair	2.685	6,600	1.228
Fiber Optic and ¼" Messenger (non-armored)	3-36	.0640	2,850	0.547
	38-72	0.739	2,850	0.580
	74-84	0.781	2,850	0.594
	86-96	0.820	2,850	0.607
	98-108	0.850	2,850	0.617
	110-120	0.889	2,850	0.630
	122-132	0.931	2,850	0.644
	134-216	0.979	2,850	0.660
	218-264	1.045	2,850	0.682
Fiber Optic and 3/8" Messenger (non-armored)	144	1.159	6,000	0.720
Fiber Optic Self Supporting Figure "8" Cable (non-armored)	2-72 & 2-36	0.949	2,850	0.650
	74-84	0.991	2,850	0.664
	86-96	1.030	2,850	0.677
	98-108	1.060	2,850	0.687
	110-120	1.099	2,850	0.700
	122-132	1.141	2,850	0.714
	134-144	1.189	2,850	0.730
¼" Messenger (CATV)	0.750	1.069	2,850	0.690
	0.635	0.883	2,850	0.628
	0.500	0.751	2,850	0.584
	0.412	0.652	2,850	0.551

Table 14 - Common Telephone & CATV Cables - Maximum Allowed Conductor Tensions and Transverse Load Factor (Wind)

New page. Info on this page was previously found on Page 3-72.

New page. Info found on this page was previously on Page 3-73.

EQUIPMENT	SQ. FT EPA	DISTANCE BELOW POLE TOP	LOAD REDUCTION FACTOR	SQ. FT. REDUCED EPA	4 LBS./ SQ. FT WIND LOAD
Capacitor Bank 9 x 50 kVAR	3	5’	90%	3	12 lbs
Capacitor Bank 6 x 200kVAR	7	5’	85%	6	24 lbs
Conductor – Primary	See Sect. 6	2’	100%		Lbs/ft x Span ft
Conductor - Secondary	See Sect. 6	8’	100%		Lbs/ft x Span ft
Conductor Comm. Allowance		11’	70%		75 lbs
Floodlight (All)	3	9’	90%	2	8 lbs
Gang Operated Switch	18	4’	90%	16	65 lbs
Primary Metering	7	6’	85%	6	24 lbs
Recloser 1- 3Ø	4	5’	90%	4	16 lbs
Regulators 3 X 100a	22	7’	85%	19	76 lbs
Regulators 3 x 219A	30	7’	85%	26	104 lbs
Streetlight (All)	4	10’	85%	3	13 lbs
Trans. 1Ø up to 75kVA	12	5’	90%	10	42 lbs
Trans. 1Ø 100kVA and up	17	5’	90%	15	61 lbs
Trans. 3 x 100 kVA	14	5’	90%	19	52 lbs
Trans. 2 x 250 kVA	21	5’	90%	19	76 lbs

Table 15 - Transverse Load Factors (Wind) for Overhead Equipment

Poles	Class 1 Factor (lbs.)	Class 2 Factor (lbs.)	Class 3 Factor (lbs.)	Class 4 Factor (lbs.)	Class 5 Factor (lbs.)
25 foot	66	62	58	53	49
30 foot	85	79	73	67	62
35 foot	104	97	90	82	75
40 foot	123	115	106	98	90
45 foot	143	133	123	114	100
50 foot	163	152	141	130	120
55 foot	184	171	159	147	--------
60 foot	205	191	177	164	--------

Table 16 - Transverse Load Factors (Wind) for Wood Poles

All loads that are applied to poles that are guyed are transferred into vertical or axial loads. Therefore the limiting factor of the pole is at what point a pole will fail due to buckling.

The following tables list these maximum loading points (lbs) based on pole class and where the guy wire is attached to the pole.

Guy Attachment from top of pole (ft)	30 FOOT POLE				
	Class 1	Class 2	Class 3	Class 4	Class 5
1	102,090	75,852	56,512	38,820	27,870
2	117,289	84,971	63,433	43,549	31,374
3	131,792	95,546	71,470	49,037	35,451
4	148,707	107,885	80,859	55,447	40,222
5	172,864	122,379	91,900	62,982	45,842
6	196,923	139,529	104,979	71,905	52,511
7	225,611	159,990	120,601	82,559	60,489
8	266,602	184,625	139,431	95,397	70,120

Table 17 - Buckling Limits for 30ft Poles (lbs)

Guy Attachment from top of pole (ft)	35 FOOT POLE						
	Class H2	Class H1	Class 1	Class 2	Class 3	Class 4	Class 5
1	131,492	104,138	79,516	59,541	43,590	31,081	21,480
2	148,445	117,905	90,152	67,613	49,590	35,436	24,552
3	163,980	130,429	99,795	74,903	54,987	39,334	27,288
4	181,651	144,688	110,779	83,211	61,140	43,781	30,411
5	206,669	165,068	126,548	95,199	70,070	50,279	35,009
6	230,377	184,254	141,348	106,411	78,389	56,304	39,252
7	257,744	206,417	158,450	119,373	88,012	63,279	44,166
8	296,277	237,901	182,845	137,948	101,876	73,388	51,339

Table 18 - Buckling Limits for 35ft Poles (lbs)

Guy Attachment from top of pole (ft)	40 FOOT POLE								
	Class H4	Class H3	Class H2	Class H1	Class 1	Class 2	Class 3	Class 4	Class 5
1	166,225	133,382	105,664	82,508	63,385	47,796	35,276	25,393	17,749
2	180,906	145,240	115,128	89,960	69,163	52,199	38,566	27,795	19,456
3	197,242	158,440	125,667	98,261	75,603	57,110	42,237	30,477	21,363
4	220,419	177,245	140,747	110,199	84,916	64,256	47,617	34,440	24,207
5	241,266	194,109	154,228	120,833	93,179	70,568	52,346	37,903	26,678
6	264,680	213,056	169,379	132,789	102,474	77,672	57,671	41,806	29,464
7	297,604	239,799	190,855	149,815	115,779	87,901	65,389	47,506	33,569
8	328,098	264,502	210,631	165,442	127,946	97,217	72,386	52,647	37,249
9	362,746	292,576	233,116	183,215	141,790	107,821	80,356	58,505	41,447
10	411,120	331,912	264,742	208,323	161,441	122,956	91,801	66,978	47,566
11	457,418	369,465	294,851	232,153	180,029	137,219	102,539	74,890	53,250
12	510,799	412,776	329,587	259,655	201,491	153,693	114,950	84,039	59,826
13	585,009	473,180	378,207	298,303	231,783	177,063	132,656	97,177	69,341

Table 19 - Buckling Limits for 40ft Poles (lbs)

New page. Info on this page was previously found on Pages 3-60 and 3-61.

Guy Attachment from top of pole (ft)	45 FOOT POLE								
	Class H4	Class H3	Class H2	Class H1	Class 1	Class 2	Class 3	Class 4	Class 5
1	129,446	104,125	82,714	63,617	48,984	37,033	26,802	19,325	13,753
2	139,856	112,569	89,485	68,834	53,047	40,145	29,064	20,982	14,964
3	151,309	121,863	96,940	74,580	57,524	43,575	31,558	22,812	16,301
4	167,734	135,257	107,741	82,914	64,058	48,617	35,234	25,532	18,317
5	181,992	146,843	117,049	90,090	69,659	52,917	38,364	27,832	20,007
6	197,789	159,683	127,368	98,046	75,872	57,690	41,838	30,389	21,886
7	220,210	177,992	142,157	109,461	84,840	64,626	46,898	34,144	24,683
8	240,172	194,239	155,232	119,545	92,727	70,697	51,320	37,406	27,090
9	262,475	212,396	169,850	130,820	101,551	77,492	56,271	41,061	29,791
10	293,836	238,039	190,593	146,835	114,156	87,261	63,403	46,367	33,761
11	322,539	261,435	209,454	161,386	125,562	96,061	69,818	51,114	37,281
12	354,942	287,855	230,760	177,826	138,454	106,012	77,074	56,487	41,270
13	400,149	324,864	260,738	200,978	156,705	120,184	87,429	64,210	47,071
14	471,721	383,762	308,719	238,078	186,151	143,220	104,305	76,915	56,750
15	523,529	426,124	342,988	264,538	206,979	159,368	116,096	85,694	63,326
16	595,235	484,969	390,783	301,470	236,191	182,135	132,753	98,178	72,774
17	665,420	542,416	437,310	337,403	264,516	204,129	148,824	110,167	81,784
18	747,031	609,236	491,444	379,213	297,486	229,741	167,541	124,138	92,293
19	859,784	701,857	566,756	437,423	343,589	265,729	193,885	143,922	107,314

Table 20 - Buckling Limits for 45ft Poles (lbs)

New page. Info on this page was previously found on Page 3-61.

Guy Attachment from top of pole (ft)	50 FOOT POLE							
	Class H4	Class H3	Class H2	Class H1	Class 1	Class 2	Class 3	Class 4
1	111,481	90,157	72,049	55,732	43,241	32,257	23,511	17,118
2	122,126	98,890	79,140	61,251	47,604	35,540	25,928	18,924
3	130,992	106,136	84,997	65,801	51,184	38,228	27,902	20,389
4	140,652	114,033	91,384	70,764	55,091	41,161	30,056	21,989
5	154,487	125,401	100,630	77,964	60,796	45,458	33,223	24,363
6	166,248	135,028	108,427	84,026	65,576	49,050	35,864	26,330
7	179,132	145,578	116,975	90,673	70,821	52,992	38,763	28,490
8	197,393	160,604	129,215	100,210	78,393	58,701	42,974	31,656
9	213,259	173,612	139,769	108,422	84,882	63,582	46,567	34,340
10	230,752	187,959	151,414	117,483	92,047	68,973	50,536	37,307
11	255,303	208,188	167,916	130,349	102,280	76,694	56,238	41,604
12	277,143	226,121	182,490	141,696	111,266	83,460	61,223	45,339
13	301,408	246,052	198,695	154,313	121,262	90,988	66,772	49,499
14	335,159	273,895	221,441	172,056	135,399	101,663	74,662	55,459
15	365,964	299,226	242,061	188,119	148,145	111,268	81,747	60,783
16	400,511	327,643	265,202	206,149	162,457	122,057	89,706	66,766
17	448,196	367,027	297,417	231,290	182,521	137,217	100,921	75,258
18	492,966	403,893	327,473	254,718	201,145	151,265	111,293	83,071
19	543,763	445,734	361,597	281,320	222,300	167,226	123,080	91,955
20	613,473	503,370	408,798	318,175	251,754	189,496	139,568	104,466

Table 21 - Buckling Limits for 50ft Poles (lbs)

New page. Info on this page was previously found on Page 3-62.

Guy Attachment from top of pole (ft)	55 FOOT POLE							
	Class H4	Class H3	Class H2	Class H1	Class 1	Class 2	Class 3	Class 4
1	98,214	78,456	61,841	48,949	37,412	28,045	20,559	15,066
2	104,694	83,654	65,956	52,247	39,949	29,961	21,974	16,123
3	111,689	89,266	70,401	55,811	42,690	32,032	23,506	17,268
4	121,834	97,422	76,877	61,037	46,724	35,089	25,776	18,980
5	130,181	104,122	82,186	65,301	50,007	37,571	27,613	20,357
6	139,227	111,385	87,943	69,926	53,569	40,265	29,608	21,853
7	152,208	121,827	96,239	76,634	58,752	44,198	32,532	24,065
8	163,092	130,570	103,172	82,213	63,052	47,453	34,945	25,878
9	174,944	140,091	110,724	88,293	67,739	51,002	37,576	27,857
10	191,773	153,637	121,493	97,015	74,483	56,125	41,390	30,750
11	206,172	165,210	130,678	104,420	80,197	60,454	44,603	33,173
12	221,936	177,881	140,736	112,533	86,458	65,200	48,126	35,830
13	244,096	195,729	154,933	124,050	95,370	71,977	53,177	39,671
14	263,471	211,310	167,307	134,045	103,089	77,832	57,528	42,961
15	284,819	228,481	180,945	145,066	111,602	84,291	62,329	46,593
16	314,549	252,436	200,011	160,556	123,599	93,422	69,141	51,786
17	341,151	273,842	217,022	174,320	134,238	101,501	75,152	56,342
18	370,692	297,616	235,917	189,615	146,062	110,482	81,835	61,411
19	411,480	330,498	262,101	210,918	162,574	123,059	91,227	68,587
20	448,913	360,635	286,066	230,341	177,600	134,480	99,734	75,052

Table 22 - Buckling Limits for 55ft Poles (lbs)

New page. Info on this page was previously found on Page 3-63.

Strut Length (feet)	Strut Height Below Guy Attachment Height (feet)	Strut Factor	Strut Length (feet)	Strut Height Below Guy Attachment Height (feet)	Strut Factor
8	6	1.250	10	6	1.166
8	7	1.329	10	7	1.221
8	8	1.414	10	8	1.281
8	9	1.505	10	9	1.345
8	10	1.601	10	10	1.414
8	11	1.700	10	11	1.487
8	12	1.803	10	12	1.562
8	13	1.908	10	13	1.640
8	14	2.016	10	14	1.720
8	15	2.125	10	15	1.803
8	16	2.236	10	16	1.887
8	17	2.349	10	17	1.972
8	18	2.462	10	18	2.059
8	19	2.577	10	19	2.147
8	20	2.693	10	20	2.236
8	21	2.809	10	21	2.326
8	22	2.926	10	22	2.417
8	23	3.044	10	23	2.508
8	24	3.162	10	24	2.600

Table 23 - Strut Factors

New page. Info on this page was previously found on Page 3-76.

New page. Info on this page was previously found on Page 3-77.

Sidewalk/Strut Guy Pole Loading Factors
Allowable Pole Design Compression at Guy Attachment Point (Ca)

Guy attachment from top of pole	35 Foot Pole			
	Class 1	Class 2	Class 3	Class 4
2'	71,089	53,351	39,161	28,009
3'	77,851	58,500	43,002	30,809
4'	85,495	64,323	47,350	33,981
5'	94,172	70,938	52,294	37,591
6'	104,068	78,488	57,941	41,720

Guy attachment from top of pole	40 Foot Pole			
	Class 1	Class 2	Class 3	Class 4
2'	56,623	42,749	31,595	22,782
3'	61,337	46,364	34,315	24,782
4'	66,578	50,385	37,342	27,012
5'	72,423	54,873	40,723	29,505
6'	78,964	59,898	44,513	32,301

Guy attachment from top of pole	45 Foot Pole			
	Class 1	Class 2	Class 3	Class 4
2'	46,876	35,590	25,864	18,755
3'	50,363	38,281	27,860	20,233
4'	54,191	41,238	30,054	21,861
5'	58,404	44,495	32,473	23,657
6'	63,053	48,090	53,147	50,965

Guy attachment from top of pole	50 Foot Pole		
	Class 1	Class 2	Class 3
2'	39,963	29,868	21,818
3'	42,658	31,920	23,350
4'	45,589	34,154	25,433
5'	48,783	36,590	26,839
6'	52,270	39,251	28,830

Table 24 - Sidewalk/Strut Guy Pole Loading Factors (Ca)

These tables are for Grade C Construction. For Grade B Construction, multiply each value by .76.

Sidewalk/Strut Guy Pole Loading Factors
Allowable Pole Design Moment at the Strut location on the pole (Ma)

Strut attachment from top of pole	35 Foot Pole			
	Class 1	Class 2	Class 3	Class 4
20’	92,710	75,424	60,433	47,572
18’	86,337	70,105	56,046	44,006
16’	80,263	65,042	51,878	40,622
14’	74,480	60,228	47,921	37,417
12’	68,983	55,659	44,171	34,384
10’	63,762	51,326	40,622	31,521
6'	58,812	47,224	37,268	28,820

Strut attachment from top of pole	40 Foot Pole			
	Class 1	Class 2	Class 3	Class 4
24’	105,962	86,948	70,357	56,024
22’	99,021	81,086	65,459	51,981
20’	92,391	75,494	60,794	48,138
18’	86,063	70,165	56,356	44,489
16’	80,030	65,092	52,139	41,029
14’	74,287	60,270	48,138	37,754
12'	68,825	55,693	44,347	34,658

Strut attachment from top of pole	45 Foot Pole			
	Class 1	Class 2	Class 3	Class 4
30’	128,270	106,313	84,142	67,720
28’	120,404	99,594	78,765	63,231
26’	112,867	93,164	73,622	58,946
24’	105,650	87,017	68,708	54,859
22’	98,748	81,146	64,018	50,965
20’	92,153	75,546	59,546	47,260
18'	85,859	70,209	55,287	43,739

Strut attachment from top of pole	50 Foot Pole			
	Class 1	Class 2	Class 3	Class 4
34'	144,595	117,142	93,404	75,742
32'	136,092	110,164	87,759	70,991
30'	127,928	103,470	82,346	66,442
28'	120,098	97,052	77,160	62,092
26'	112,594	90,905	72,197	57,936
24'	105,410	85,024	67,452	53,970
22'	98,537	79,401	62,919	50,189

Table 25 - Sidewalk/Strut Guy Pole Loading Factors (Ma)

New page. Info on this page was previously found on Page 3-78.

Strut Length	Standard Weight Galvanized Pipe	
(Ft.)	2 Inches	2 ½ Inches
6	21,175	38,386
7	17,922	34,289
8	14,959	30,890
9	12,166	26,248
10	9,876	22,253
11	8,089	18,760
12	6,816	15,691

Table 26 - Pipe Strut Compression Capacity (lbs)

New page. Info on this page was previously found on Page 3-79.

Guy Attachment Height on Pole Above Ground (feet)	Guy Lead Length from Center of Pole to Anchor (feet)																		
	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
20	3.027	2.693	2.437	2.236	2.075	1.944	1.835	1.744	1.667	1.601	1.544	1.495	1.452	1.414	1.381	1.351	1.325	1.302	1.281
21	3.162	2.809	2.539	2.326	2.155	2.016	1.900	1.803	1.720	1.650	1.589	1.537	1.491	1.450	1.414	1.382	1.354	1.329	1.306
22		2.926	2.641	2.417	2.236	2.088	1.966	1.863	1.775	1.700	1.635	1.579	1.530	1.487	1.448	1.414	1.384	1.357	1.332
23		3.044	2.744	2.508	2.318	2.162	2.032	1.923	1.831	1.751	1.682	1.623	1.570	1.524	1.483	1.447	1.414	1.385	1.359
24		3.162	2.848	2.600	2.400	2.236	2.100	1.985	1.887	1.803	1.730	1.667	1.611	1.562	1.519	1.480	1.445	1.414	1.386
25			2.952	2.693	2.483	2.311	2.168	2.047	1.944	1.855	1.778	1.711	1.653	1.601	1.555	1.514	1.477	1.444	1.414
26			3.057	2.786	2.566	2.386	2.236	2.109	2.001	1.908	1.827	1.757	1.695	1.640	1.592	1.548	1.509	1.474	1.443
27			3.162	2.879	2.650	2.462	2.305	2.172	2.059	1.962	1.877	1.803	1.738	1.680	1.629	1.583	1.542	1.505	1.472
28				2.973	2.735	2.539	2.375	2.236	2.118	2.016	1.927	1.849	1.781	1.720	1.667	1.619	1.575	1.537	1.501
29				3.068	2.820	2.615	2.445	2.300	2.177	2.070	1.977	1.896	1.825	1.761	1.705	1.655	1.609	1.568	1.532
30				3.162	2.905	2.693	2.515	2.365	2.236	2.125	2.028	1.944	1.869	1.803	1.744	1.691	1.644	1.601	1.562
31					2.990	2.770	2.586	2.430	2.296	2.180	2.080	1.991	1.914	1.845	1.783	1.728	1.678	1.634	1.593
32					3.076	2.848	2.657	2.495	2.356	2.236	2.131	2.040	1.959	1.887	1.823	1.765	1.713	1.667	1.624
33					3.162	2.926	2.728	2.560	2.417	2.292	2.184	2.088	2.004	1.929	1.863	1.803	1.749	1.700	1.656
34						3.005	2.800	2.626	2.477	2.349	2.236	2.137	2.050	1.972	1.903	1.841	1.785	1.734	1.688
35						3.083	2.872	2.693	2.539	2.405	2.289	2.187	2.096	2.016	1.944	1.879	1.821	1.768	1.720
36						3.162	2.944	2.759	2.600	2.462	2.342	2.236	2.142	2.059	1.985	1.918	1.857	1.803	1.753
37							3.017	2.826	2.662	2.519	2.395	2.286	2.189	2.103	2.026	1.957	1.894	1.838	1.786
38							3.089	2.893	2.724	2.577	2.449	2.336	2.236	2.147	2.067	1.996	1.931	1.873	1.819
39							3.162	2.960	2.786	2.635	2.503	2.386	2.283	2.191	2.109	2.035	1.969	1.908	1.853
40								3.027	2.848	2.693	2.557	2.437	2.331	2.236	2.151	2.075	2.006	1.944	1.887
41								3.095	2.911	2.751	2.611	2.488	2.378	2.281	2.194	2.115	2.044	1.979	1.921
42								3.162	2.973	2.809	2.665	2.539	2.426	2.326	2.236	2.155	2.082	2.016	1.955
43									3.036	2.868	2.720	2.590	2.474	2.371	2.279	2.196	2.120	2.052	1.990
44									3.099	2.926	2.775	2.641	2.522	2.417	2.322	2.236	2.159	2.088	2.024
45									3.162	2.985	2.830	2.693	2.571	2.462	2.365	2.277	2.197	2.125	2.059
46										3.044	2.885	2.744	2.619	2.508	2.408	2.318	2.236	2.162	2.094
47										3.103	2.940	2.796	2.668	2.554	2.451	2.359	2.275	2.199	2.129
48										3.162	2.995	2.848	2.717	2.600	2.495	2.400	2.314	2.236	2.165
49											3.051	2.900	2.766	2.646	2.539	2.441	2.353	2.273	2.200
50											3.107	2.952	2.815	2.693	2.582	2.483	2.393	2.311	2.236

Table 27 - Guy Factors

New page. Info on this page was previously found on Page 3-74.

3.7 Worksheets and Examples

The following worksheets are provided to assist in determining the appropriate pole class for tangent distribution pole structures. The method followed by the worksheet is valid for span lengths with a ratio less than 3:1. For span lengths that have a ration of 3:1 or greater, apply the wind load perpendicular on the longest span. The wind applied to the shorter span shall be multiplied by the cosine of the line angle.

The worksheets are divided into three sections:
1. Axial load due to wind on conductors and equipment.
2. Weight of conductors and equipment on the pole.
3. Axial load due to conductor tension.

Step	Action
1	Fill in the appropriate information on the worksheet.
2	Subtotal the separate sections of the worksheet.
3	Calculate the total axial load that will be applied to the pole.
4	Select the appropriate pole. **3.4** Select the Axial Loading table for the pole height used. **3.5** Determine the lowest guy attachment point on the pole **3.6** Choose the lowest pole class that will support the axial load imposed upon the pole. **Note:** There are circumstances where if the communications utilities were to be removed that a greater pole class would be required to support the electric utilities facilities. Therefore, always select the highest pole class determined from the worksheet.

Table 28 - Worksheet Instructions

New page. Info on this page was previously found on Page 3-59.

3.7.10 Angle Pole Worksheet - 0° to 60°

Transverse Load Due to Wind

Conductor Name/Size	Number of Cond.		Ave. Span Length of Conductor (ft)		Transverse Load of Conductor or Equipment (lbs)		Cosine of 1/2 the line angle		H/L of the guy supporting the conductors		Total Axial Load on the pole (lbs)
Primary Distribution Conductor(s)											
		X		X		X		X		=	
		X		X		X		X		=	
		X		X		X		X		=	
Neutral Conductors											
		X		X		X		X		=	
Secondary Conductors											
		X		X		X		X		=	
		X		X		X		X		=	
Communications Conductor(s)											
		X		X		X		X		=	
		X		X		X		X		=	
		X		X		X		X		=	
		X		X		X		X		=	
Service Conductor(s)											
		X		X		X		X		=	
		X		X		X		X		=	
Equipment											
								X		=	
								X		=	
								X		=	
Transverse Axial Loading Due to Wind										=	

Weight of Conductors and Equipment

Conductor Name/Size	Number of Conductors or Equipment		Average Span of Conductor		Wt. per ft w/ice of Cond. Or Wt of Equip. (lbs)		Total
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
Weight of Conductors and Equipment						=	

New page. Info on this page was previously found on Page 3-65.

7/18 – Revised footnote to refer to correct tables.

Transverse Load Due to Conductor Tension

Conductor Name/Size	Number of Cond.		Max. Cond. Tension (See Section 6)		Sine of 1/2 the line angle		H/L of the guy supporting the conductors		Axial Load on the pole (lbs)
Primary Distribution Conductor(s)									
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
Neutral Conductor									
		X		X		X		=	
Secondary Conductor(s)									
		X		X		X		=	
		X		X		X		=	
Communications Conductor(s)									
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
Transverse Axial Loading Due to Conductor Tension								=	

Transverse Axial Loading Due to Service Conductor Tension

Conductor Name/Size	Number of Cond.		Max. Cond. Tension (See Section 6)		Sine of 1/2 the line angle		H/L of the guy supporting the conductors		Axial Load on the pole (lbs)
Service Conductors									
		X		X		X		=	
		X		X		X		=	
Transverse Axial Loading Due to Service Conductor Tension								=	

	Transverse Axial Loading Due to Wind (lbs)		Wt of Cond. And Equipment (lbs)		Transverse Axial Loading Due to Cond. Tension (lbs)		Transverse Axial Loading Due to Service Cond. Tension (lbs)		Grade C & B Overload Capacity Factor	
Total Axial Load Applied to Pole =	(	+		+		+	)	X	**2.20**	

Refer to the appropriate pole buckling limit table (Tables 17-22) based on pole height to determine the correct class of pole to install.

3.7.20 Deadend Pole Worksheet

Transverse Load Due to Wind

Conductor Name/Size	Number of Cond.		1/2 of the span length (ft)		Transverse Load of Cond. (lbs)		H/L of the guy supporting the conductors		Axial Load on the pole (lbs)
Primary Distribution Conductor(s)									
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
Neutral Conductor									
		X		X		X		=	
Secondary Conductor									
		X		X		X		=	
Communications Conductor(s)									
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
		X		X		X		=	
Equipment									
						X		=	
						X		=	
Transverse Axial Loading Due to Wind								=	

Transverse Load Due to Wind on Service Conductors

Conductor Name/Size	Number of Cond.		Avg. span length of Cond. (ft)		Transverse load of Cond. (lbs)		Cosine of the line Angle		H/L of the guy supporting the conductors		Total Axial Load on Pole (lbs)
Service											
		X		X		X		X		=	
		X		X		X		X		=	
Transverse Axial Loading Due to Wind on Service Conductors										=	

New page. Info on this page was previously found on Page 3-67.

New page. Info on this page was previously found on Page 3-68.

Weight of Conductors and Equipment

Conductor or Equipment Name/Size	Number of Conductors or Equipment		Average Span of Conductors		Wt per ft w/ice of Cond. Or Wt of Equipment (lbs)		Total
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
Transverse Load Due to Conductor Tension						=	

Transverse Load Due to Conductor Tension

Conductor or Equipment Name/Size	Number of Conductors or Equipment		Average Span of Conductors		Wt per ft w/ice of Cond. Or Wt of Equipment (lbs)		Total
Primary Distribution Conductor(s)							
		X		X		=	
		X		X		=	
		X		X		=	
Neutral Conductor							
		X		X		=	
Secondary Conductors							
		X		X		=	
		X		X		=	
Communications Conductor(s)							
		X		X		=	
		X		X		=	
		X		X		=	
		X		X		=	
Transverse Axial Loading Due to Conductor Tension						=	

Transverse Loading Due to Service Conductor Tension

Conductor Name/Size	Number of Cond.		Max. cond. Tension (See Section 6)		Sine of 1/2 of the line angle		H/L of the guy supporting the conductors		Axial Load on Pole (lbs)
Service Conductor(s)									
		X		X		X		=	
		X		X		X		=	
Transverse Axial Loading Due to Service Conductor Tension								=	

	Trans. Axial Loading Due to Wind (lbs)		Trans. Axial Loading Due to Wind on Serv. Cond.		Wt of Equipment		Trans. Axial Loading Due to Cond. Tension (lbs)		Trans. Axial Loading Due to Serv. Cond. Tension (lbs)		Grade C & B Overload Capacity Factor		
Total Axial Load Applied to Pole =	(	+		+		+		+	)	X	**2.20**	=	

Refer to the appropriate pole buckling limit table (Tables 17-22) based on pole height to determine the correct class of pole to install.

7/18 – Revsied footnote below second table to refer to correct tables.

RESULTS

Enter information below. Select the highest pole class from the results.

Participants of Pole	Guy Lead (ft)	Lowest Guy Attachment from top of pole (ft)	Pole Class
Electric and Communications Conductors			
Electric (one guy)			
Electric (two guys)			

EXAMPLE: Line design requires a 45 ft. pole with a calculated Total Axial Load of 19,000 lbs. determined by using the worksheet above. Look up 19,000 lbs in Table 19~~Table 19~~ for a 45 ft pole and start with the lowest guy attachment. For this example, assume a 15 ft. guy attachment (Communications guy), 1 ft. guy attachment (Electric primary guy) and 8 ft. guy attachment (Electric secondary guy if used) and record results in the table below. Select the highest class pole so if communications are removed from a pole, the pole is still strong enough for the remaining electric facilities.

Participants of Pole	Guy Lead	Lowest Guy Attachment from top of pole	Pole Class
Electric and Communications Conductors	**15 ft**	**15 ft**	**5**
Electric (one guy)	**15 ft**	**1 ft**	**4**
Electric (two guys)	**15 ft**	**8 ft**	**5**

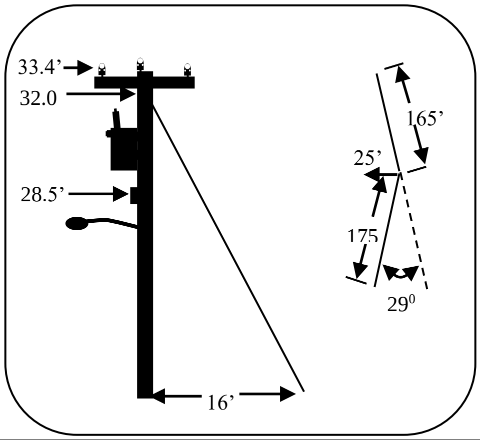
Supersedes issue 7/17 – Revised Wind Load Tensions (WLT) for 3 – 477 Kcmil AL bare.

In this example, the highest class pole is a Class 4 pole which would be the correct selection.

3.7.30 EXAMPLE #1: ANGLE GUYING

Given:

15 kV class construction
150 ft. ruling span
175 ft. actual front span
165 ft. actual back span
1 – 40 ft., class 3 wood pole
3 – 477 kcmil Al AAC bare conductors (W21BA)
1 – 3/c – 1/0 Al triplex secondary cable (W15C)
1 street light (attachment height = 27 ft.)
1 – 50 kVA transformer
(attachment height = 30 ft.)
Corner Pull – 25 ft. or 29 degrees
Grade B construction
Soil Classification = 4



Transverse Wind Loading: Steps 1-6

Step	Action	Use
1	Determine Conductor Wind Load Tensions (WLT) from Sections 6 and 11.	3 - 477 kcmil Al bare (W21BA) = 0.598 lbs./ft. 1 - 3/c 1/0 Al triplex secondary cable (W15C) = 0.666 lbs./ft.
2	Calculate Total Conductor Wind Load Tension.	Total Conductor Wind Load Tension (WLT) = (No. of Conductors) x (Conductor WLT) x (Back Span + Front Span) / 2 x (Conductor/Equipment Height /Guy Height) Total Conductor Wind Load Tension = *(3 x 0.598 lbs. / ft.) x ((175 ft. + 165 ft.) / 2) x (33.4/32) +* *(1 x 0.666 lbs. / ft.) x ((175 ft. + 165 ft.) / 2) x (28.5/32) = 419.16 lbs.*
3	Determine and calculate Total Equipment Wind Load Tension from Table 15~~Table 15~~ and Table 16~~Table 16~~.	Equipment Wind Load = Wind load x (Attachment height/Guy height) 1 – 40 ft. Class 3 wood pole (Table 16~~Table 16~~) = 106 lbs x (17 ft./32 ft.) = **57 lbs.** 1 – 50 kVA transformer (Table 15~~Table 15~~) = 42 lbs x (30 ft./32 ft.) = **40 lbs.** 1 – streetlight (Table 15~~Table 15~~) = 13 lbs x (27 ft./32 ft.) = **11 lbs.** Total Equipment Transverse Wind Load = **108 lbs.**
4	Calculate Transverse Wind Loading.	Transverse Wind Loading = (Total Conductor Transverse Wind Loading) + (Total Equipment Transverse Wind Loading) Transverse Wind Loading – 419.16 lbs. + 108 lbs. = 527.16 lbs.
5	Determine Construction Grade Overload Factor from Table 11~~Table 11~~.	Grade B, Transverse Loads: Wind, Overload Factor = 2.50
6	Calculate Total Transverse Wind Loading.	Total Transverse Wind Loading = (Transverse Wind Loading) x (Overload Factor) Total Transverse Wind Loading = 527.16 lbs. x 2.50 = **1,317.9 lbs**.

EXAMPLE #1: ANGLE GUYING (continued)

Transverse Wire Tension Steps 7-11

Step	Action	Use
7	Determine Conductor Tensions from Section 6 and Section 10	3 - 477 kcmil Al AAC bare (W21BA) = 2,000 lbs. 1 - 3/c 1/0 Al triplex secondary cable (W15C) = 1,925 lbs.
8	Calculate Total Tension at the guy attachment height.	Total Conductor Tension = $(No.ofConductors)x\left(\frac{ConductorHeight}{GuyHeight}\right)x(ConductorTension)$ Total Conductor Tension = $\left(3x\frac{33.4\,ft.}{32.0\,ft}x2{,}000lbs.\right)+\left(1x\frac{28.5\,ft.}{32.0\,ft.}x1{,}925lbs.\right)=7{,}977lbs.$
9	Determine Line Angle Factor from Table 13~~Table 13~~.	Pull = 25 ft.; Line Angle = 29 degrees; Line Angle Factor = 0.5008
10	Determine Construction Grade Overload Factor from Table 11~~Table 11~~.	Grade B, Transverse loads: Wire Tension, Overload Factor = 1.65
11	Calculate Transverse Wire Tension.	Transverse Wire Tension = (Total Conductor Tension) x (Line Angle Factor) x (Overload Factor) Transverse Wire Tension = 7,977 lbs. x 0.5008 x 1.65 = 6,592 lbs.

Anchor Guy Requirements Steps 12-17

Step	Action	Use
12	Calculate Total Transverse Tension.	Total Transverse Tension = (Transverse Wind Loading) + (Transverse Wire Tension) Total Transverse Tension = 1,317.9 lbs. + 6,592 lbs. = 7,09.9 lbs.
13	Determine Guy Factor from Table 27~~Table 27~~	Guy Height = 32.0 ft.; Guy Lead = 16 ft.; Guy factor = 2.236
14	Calculate Total Tension in guy wire and anchor.	Tension (guy wire) = (Total Transverse Tension) x (Guy Factor) Tension (guy wire) = 7,909.9 lbs. x 2.236 = 17,686.5 lbs. Tension in guy wire = tension in anchor (except sidewalk guys)
15	Determine guy wire Strength Factor from Table 12~~Table 12~~.	Grade B, guy wire, Strength Factor = 0.9 Grade B, anchor, Strength Factor = 1.0
16	Determine Guy Wire and Anchor Requirements.	Guy Wire Req. = $\frac{Tension(GuyWire)}{StrengthFactor}=\frac{17{,}686.5}{.9}=19{,}651.7lbs.$ Anchor Req. = $\frac{Tension(Anchor)}{StrengthFactor}=\frac{17{,}686.5}{1.0}=17686.5lbs.$
17	Determine Guy Components from Table 2~~Table 2~~, Table 4~~Table 4~~, Table 7~~Table 7~~, etc.	**Guy Wire Required = 19,651.7 lbs**. Use a 25M guy (looped 12.5M guy wire) (G15A) with one 54 in. strain insulator (30,000 lbs.) (TI95C) **Anchor Required = 17,686.5 lbs** Soil Class = 4 Use one 14 in. Helix (A16B) with one 1in. x 7 ft. rod (A18K)

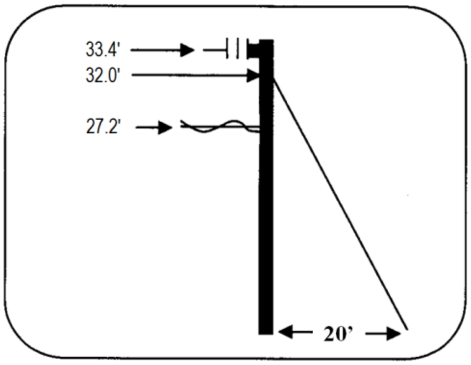
Supersedes 7/17 issue – Calculation revised due to change in 3 -477 kcmil WLT.

Note: Refer to Section 3.7.10 Angle Pole Worksheet - 0° to 60° to ensure pole meets buckling requirements.

3.7.40 EXAMPLE #2: DEADEND GUYING

Given:

15 kV class construction
150 ft. ruling span
1 – 40 ft., class 3 wood pole
3 – 1/0, Al AAAC, bare conductors (W14B)
1 – 3/c – 1/0 Al. triplex secondary cable ((W15C)
Grade C construction
Soil Classification = 4



Transverse Wire Tension: Steps 1-8

Step	Action	Use
1	Determine Conductor Tensions from Section 6 and Section 10	1 - 1/0 Al AAAC, bare (W14B) = 2,000 lbs. 1 - 3/c 1/0 Al secondary cable (W15C) = 1,925 lbs.
2	Calculate Total Conductor Tension at the guy attachment height	Total Conductor Tension = $(No.ofConductors)x\left(\frac{ConductorHeight}{GuyHeight}\right)x(ConductorTension)$ Total Conductor Wind Load Tension = $\left(3x\frac{33.4\,ft.}{32.0\,ft.}x2{,}000lbs.\right)+\left(1x\frac{27.2\,ft.}{32.0\,ft.}x1{,}925lbs.\right)=7{,}899lbs.$
3	Determine Guy Factor from Table 27~~Table 27~~	Guy Height = 32.0 ft.; Guy Lead = 20 ft.; Guy Factor = 1.887
4	Determine Construction grade Overload Factor from Table 11~~Table 11~~.	Grade C, Longitudinal loads: Deadends, Overload Factor = 1.10
5	Calculate Tension in guy wire and anchor	Tension (guy wire) = (Total Conductor Tension) x (Guy Factor) x (Overload Factor) Tension (guy wire) = 7,899 lbs. x 1.887 x 1.10 = 14,906 lbs. Tension in guy wire – tension in anchor (except sidewalk guys).
6	Determine guy wire and anchor Strength Factor from Table 12~~Table 12~~.	Grade C, guy wire, Strength Factor = 0.9 Grade C, anchor, Strength Factor = 1.0
7	Determine guy wire and anchor requirements	$GuyWire\,\mathrm{Re}\,q.=\frac{Tension(GuyWire)}{(StrengthFactor)}=\frac{14{,}906lbs.}{0.9}=16{,}562lbs.$ $Anchor\,\mathrm{Re}\,q.=\frac{Tension(anchor)}{(StrengthFactor)}=\frac{14{,}906lbs.}{1.0}=14{,}906lbs.$
8	Determine Guy Components from Table 2~~Table 2~~, Table 4~~Table 4~~, Table 7~~Table 7~~, etc.	**Guy wire required = 16,562 lbs**. Use a 25M guy (looped 12.5M guy wire) (G15A) with one 54 in. strain insulator (30,000 lbs.) (TI-95B) **Anchor required = 14,906 lbs** Soil class = 4 Use one 10 in. Helix (A16A) with one 1 in. x 7 ft. rod (A18K)

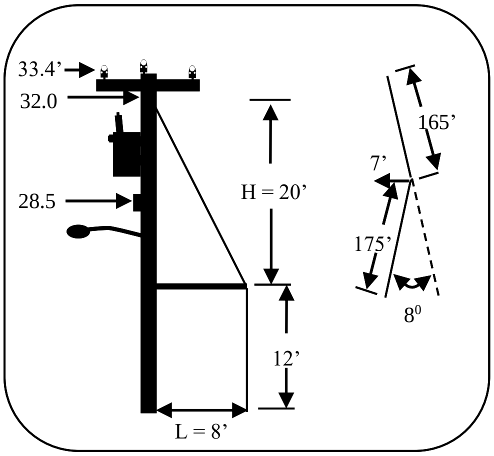
Supersedes 7/10 Issue – Revised secondary attachment point per 9-417

Note: Anchors and anchor rods installed for joint company use must be sized to hold both electric and telephone company conductors and equipment.

3.7.50 EXAMPLE #3: SIDEWALK/STRUT GUYING

Given:

15 kV class construction
150 ft. ruling span
175 ft. actual front span
165 ft. actual back span
1 – 40 ft., class 3 wood pole
3 – 1/0 AAAC, bare conductors (W14B)
1 – 3/c 1/0 Al triplex secondary cable (W15C)
1 – streetlight (attachment height = 27 ft.)
1 – 50 kVA transformer
(attachment height = 30 ft.)
Corner Pull – 7 ft. or 8 degrees
Grade B construction
Pole height above ground – 34 ft.
Soil Classification = 4
Strut attachment from top of pole = 22 ft.



Transverse Wind Loading: Steps 1-6

Step	Action	Use
1	Determine Conductor Wind Load Tensions from Sections 6 and 10.	3- -1/0 Al AAAC, bare (W14B) bare = 0.4656 lbs./ft. 1- 3/c 1/0 Al. triplex secondary cable (W15C) = 0.652 lbs./ft.
2	Calculate Total Conductor Wind Load Tension	Total Conductor Wind Load Tension = (No. of Conductors) x (Conductor WLT) x $\frac{\text{(Back Span + Front Span)}}{2}$ x (Conductor/Equipment Height /Guy Height) Total Conductor Wind Load Tension = $(3x0.4656 lbs./\ ft.)x\left(\frac{175ft.+165ft.}{2}\right)x\frac{33.4}{32}+$ $(1x0.652 lbs./\ ft.)x\left(\frac{175ft.+165ft.}{2}\right)x\frac{28.5}{32}=347 lbs.$
3	Determine and calculate Total Equipment Wind Load Tension from Table 15~~Table 15~~ and Table 16~~Table 16~~.	Equipment Wind Load = Wind load x (Attachment height/Guy height) 1 – 40 ft. Class 3 wood pole (Table 16~~Table 16~~) = 125 lbs. x (17 ft./32 ft.) = **66 lbs**. 1 – 50 kVA transformer (Table 15~~Table 15~~) = 42 lbs. x (30 ft./32 ft.) = **38 lbs.** 1 – streetlight (Table 15~~Table 15~~) = 13 lbs. x (27 ft./32 ft. = **11 lbs.** Total Equipment Transverse Wind Load = **115 lbs.**
4	Calculate Transverse Wind Loading	Transverse Wind Loading = (Total Conductor Transverse Wind Loading) + (Total Equipment Transverse Wind Loading) Transverse Wind Loading – 347 lbs. + 115 lbs. = 462 lbs
5	Determine Construction Grade Overload Factor from Table 11~~Table 11~~.	Grade B, Transverse Loads: Wind, Overload Factor = 2.50
6	Calculate Total Transverse Wind Loading	Total Transverse Wind Loading = (Transverse Wind Loading) x (Overload Factor) Total Transverse Wind Loading = 462 lbs. x 2.50 = **1,155 lbs**.

New page. Info on this page was previously found on Page 3-54.

New page. Info on this page was previously found on Page 3-55.

EXAMPLE #3: SIDEWALK GUYING (continued)

Transverse Wire Tension Steps 7-18

Step	Action	Use
7	Determine Conductor Tensions from Section 6.	3 - 1/0 Al AAAC, bare (W14B) bare = 2,000 lbs. 1 - 3/c 1/0 Al triplex secondary cable (W15C) = 1,925 lbs.
8	Calculate Total Tension at the guy attachment height.	Total Conductor Tension = $(No.ofConductors)x\left(\frac{ConductorHeight}{GuyHeight}\right)x(ConductorTension)$ Total Conductor Tension = $\left(3x\frac{33.4\,ft.}{32.0\,ft}x2{,}000lbs.\right)+\left(1x\frac{28.5\,ft.}{32.0\,ft.}x1{,}925lbs.\right)=7{,}977lbs.$
9	Determine Line Angle Factor from Table 13~~Table 13~~.	Pull = 7 ft.; Line Angle = 8 degrees; Line Angle Factor = 0.1395
10	Determine Construction Grade Overload Factor from Table 11~~Table 11~~.	Grade B, Transverse loads: Wire Tension, Overload Factor = 1.65
11	Calculate Transverse Wire Tension	Transverse Wire Tension = (Total Conductor Tension) x (Line Angle Factor) x (Overload Factor) Transverse Wire Tension = 7,977 lbs. x 0.1395 x 1.65 = 1,836 lbs.
12	Calculate Total Transverse Tension	Total Transverse Tension = (Transverse Wind Loading) + (Transverse Wire Tension) Total Transverse Tension = 1,155 lbs. + 1,836 lbs = 2,991 lbs.
13	Calculate Tension on the anchor	Tension (anchor) = (Total Transverse Tension) x (Pole height above ground) (Strut Length) $Tension(anchor)=2{,}991lbs.x\frac{34\,ft.}{8\,ft.}=12{,}712lbs.$
14	Calculate Compression on the strut	Compression (Strut) = Total Transverse Tension) x (Pole height above ground) (Guy attach height – strut attach height) $Compression(Strut)=2{,}991lbs.x\frac{(34\,ft.)}{(32\,ft.-12\,ft.)}=5{,}085lbs.$
15	Determine the Strut Factor from Table 23~~Table 23~~.	Strut length = 8 ft., Guy attachment height less Strut attachment height = 20 ft. Strut Factor = 2.693
16	Calculate tension in guy wire	Tension (guy wire) = (Compression (strut) x Strut Factor) Tension (guy wire) = 5,085 lbs. x 2.693 = 13,694 lbs.
17	Determine guy wire and anchor Strength Factor from Table 12~~Table 12~~.	Grade C, guy wire, Strength Factor = 0.9 Grade C, anchor, Strength Factor = 1.0
18	Determine guy wire and anchor requirements	$GuyWire\,Req.=\frac{Tension(GuyWire)}{StrengthFactor}=\frac{13{,}694lbs.}{0.9}=15{,}216lbs.$ $Anchor\,Req.=\frac{Tension(Anchor)}{StrengthFactor}=\frac{12{,}712lbs.}{1.0}=12{,}712lbs.$ Tension (guy wire) will always be greater than tension (anchor) on all

		sidewalk guying installations.

EXAMPLE #3: SIDEWALK GUYING (continued)

Transverse Wire Tension (continued) Step 19

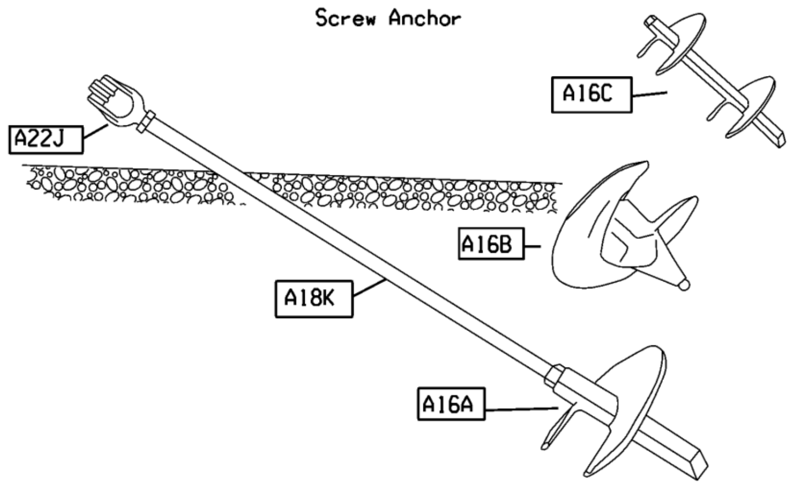
Step	Action	Use
19	Determine Guy Components from Table 2~~Table 2~~, Table 4~~Table 4~~, Table 7~~Table 7~~, etc.	**Guy required = 15,443 lbs.** Use a 25M guy (looped 12.5M guy wire) (G15A) with one 54 in. strain insulator (30,000 lbs.)(TI-95B) **Anchor required = 12,903 lbs.** Soil class = 4 Use one 10 in. Helix (A16A) with one 1 in. x 7 ft. rod (A18K)

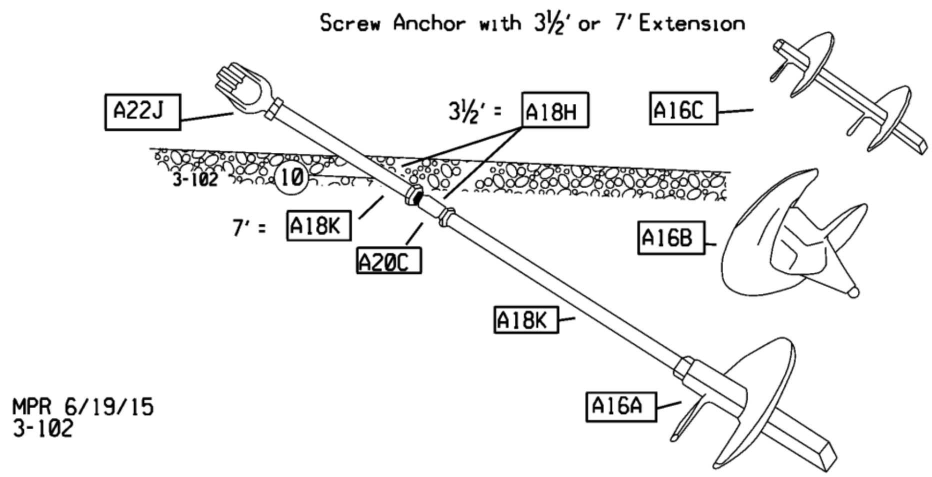
Pole Moment & Compression Strength Steps 20-26

Step	Action	Use
20	Determine Pole Moment (M) and Compression (CC)	M equals (Pole height above ground minus distance between guy attachment and strut attachment (H) times horizontal load). CC equals anchor tension determined from Step 13.
21	Calculate Pole Moment (M)	M = (34 ft. – 20 ft.) x 2,991lbs. = **41,874 ft-lbs**.
22	Calculate Compression (CC)	From Step 13, CC = **12,712 lbs**.
23	Determine lowest guy attachment from top of pole	Lowest guy attachment is 2 ft. from top of pole
24	Determine allowable Pole Moment (Ma) and Compression (Ca) from Table 25~~Table 25~~ and Table 24~~Table 24~~.	A safely loaded pole is determined by the equation **CC/Ca + M/Ma<1**
25	Calculate if Pole Size and Class are adequate for attached load.	From Sidewalk/Strut guy Pole Loading Factor Tables for a 40 ft., Class 3 pole Calculate if CC/Ca + M/Ma<1 Lowest guy attachment is 2 ft. from top of pole: **Ca** = **31,595** from Table 24~~Table 24~~ Strut attachment 22 ft. from top of pole: **Ma** = **65,459** from Table 25~~Table 25~~ **CC = 12,712** from Step 13 **M = 41,874** from Step 21 Therefore, (12,712/31,595) + (41,874/65,459) = **1.04**
26	Determine if pole is adequate	Since 1.04 is more than 1, a 40 ft. Class 3 pole is not adequate so a 40 ft. Class 2 pole is required.

New page. Info on this page was previously found on Page 3-56.

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission, and Sub-transmission with distribution accounting.





Supersedes 7/09 Issue – Eliminated anchor stick-up of 6" -10" , added flight embedment requirement, and added CU note

To achieve maximum holding capacity, the torque applied should approach 5,500 foot-pounds and the upper-most anchor flight shall be a minimum of 5 times the largest flight diameter below grade. This can be translated to hydraulic auger gauge pressure (psi) per the following table.

Hydraulic Auger Gauge Pressure (psi)	Applied Torque Low Speed (ft.-lbs.)	Predicted Holding Capacity (lbs.)	
		10" Screw Anchor Helix	14" Screw Anchor Helix
750	1,600	11,200	16,000
1,000	3,250	22,750	25,000
1,250	5,000	34,000	37,000

Notes:

1. To assure an adequate screw anchor installation, use these values if the digger has a hydraulic auger pressure gauge. Contact Standards to confirm that your digger has the gauges necessary to utilize this information. The digger operator should notify the designer / engineer what anchor holding strength was achieved based on applied auger gauge pressure. If the desired holding strength is not achieved, continue installing the anchor rod deeper with a 3.5 ft. or 7 ft. extension rod. If the desired holding strength is still not achieved, consider installing a second anchor rod with additional guys.
2. Disturb the soil as little as possible.
3. Maintain alignment during installation.
4. Do not use more than one (1) extension rod per installation.

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission, and Sub-transmission with distribution accounting.

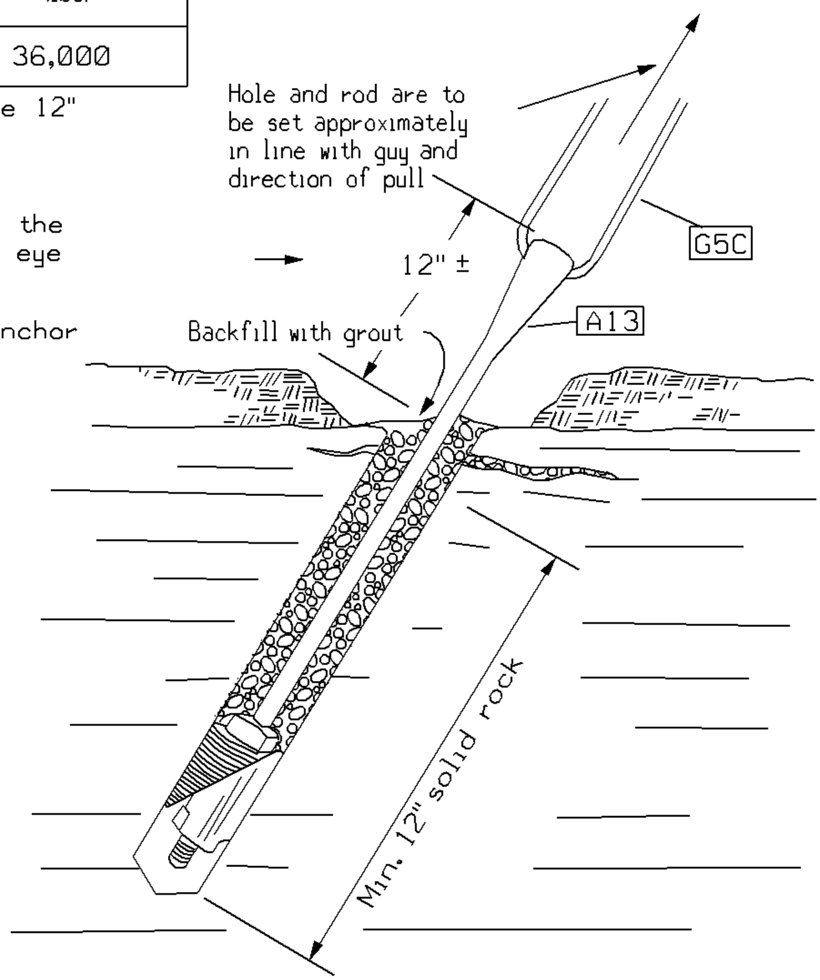
Guidelines for Installation of the expanding rock anchor are as follows:

1. Remove the soil to the top of the rock layer.

2. Drill the properly sized hole, in line with the final installed guy angle, into the solid rock. The drill hole must be clean and smooth and sized per the chart below.

Anchor Rod Diameter	Anchor Size	Required Hole Size	Holding Strength (lbs)
1"	2¼"	2⅜"	36,000

Minimum depth for the hole should be 12" into the solid rock.



3. Insert the unexpanded anchor into the hole and insert a bar through the eye of the anchor rod.

4. Turn the bar clockwise until the anchor is firmly expanded against the sides of the hole.

5. Test pull the anchor before backfilling by applying a load in the direction of the final guy angle.
   If the anchor is properly set, there should be no movement or creep of the anchor while applying the test load. If creep does occur (under load) corrective action is required, since this movement would indicate that the anchor is set in soft, weathered rock or possibly in a rock joint or fracture zone in the rock.

6. Where corrective action is necessary, additional drilling into sound rock and resetting of the anchor should be attempted. Where the rock is indicated to be soft or weathered, the installation of a twin 4" screw anchor should be attempted.

7. Rock anchors shall be backfilled with a sand-cement grout to keep out surface water that could result in deterioration of the rock through freezing and thawing.

Supersedes 7/07 Issue – Added CU note.

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission, and Sub-transmission with distribution accounting.

Use this hand-dug anchor when a screw anchor cannot be installed due to surrounding obsticles such as cable or pipes.

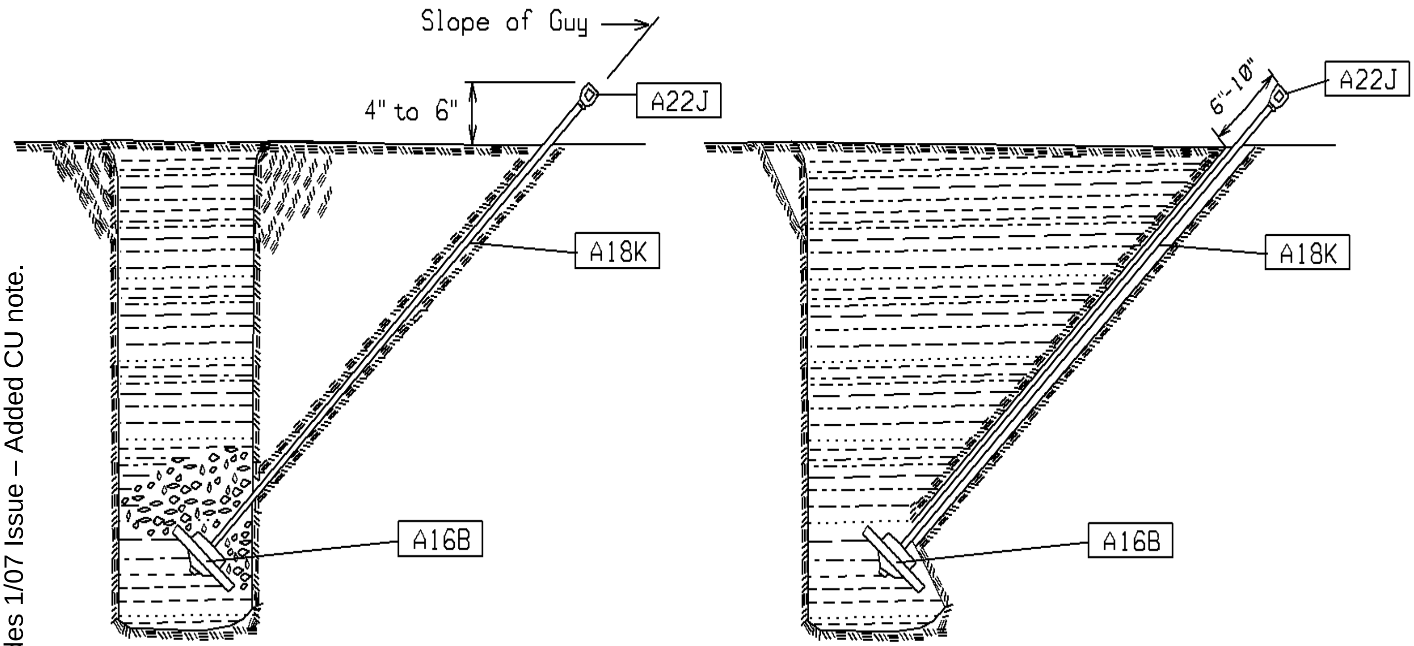


Figure 1

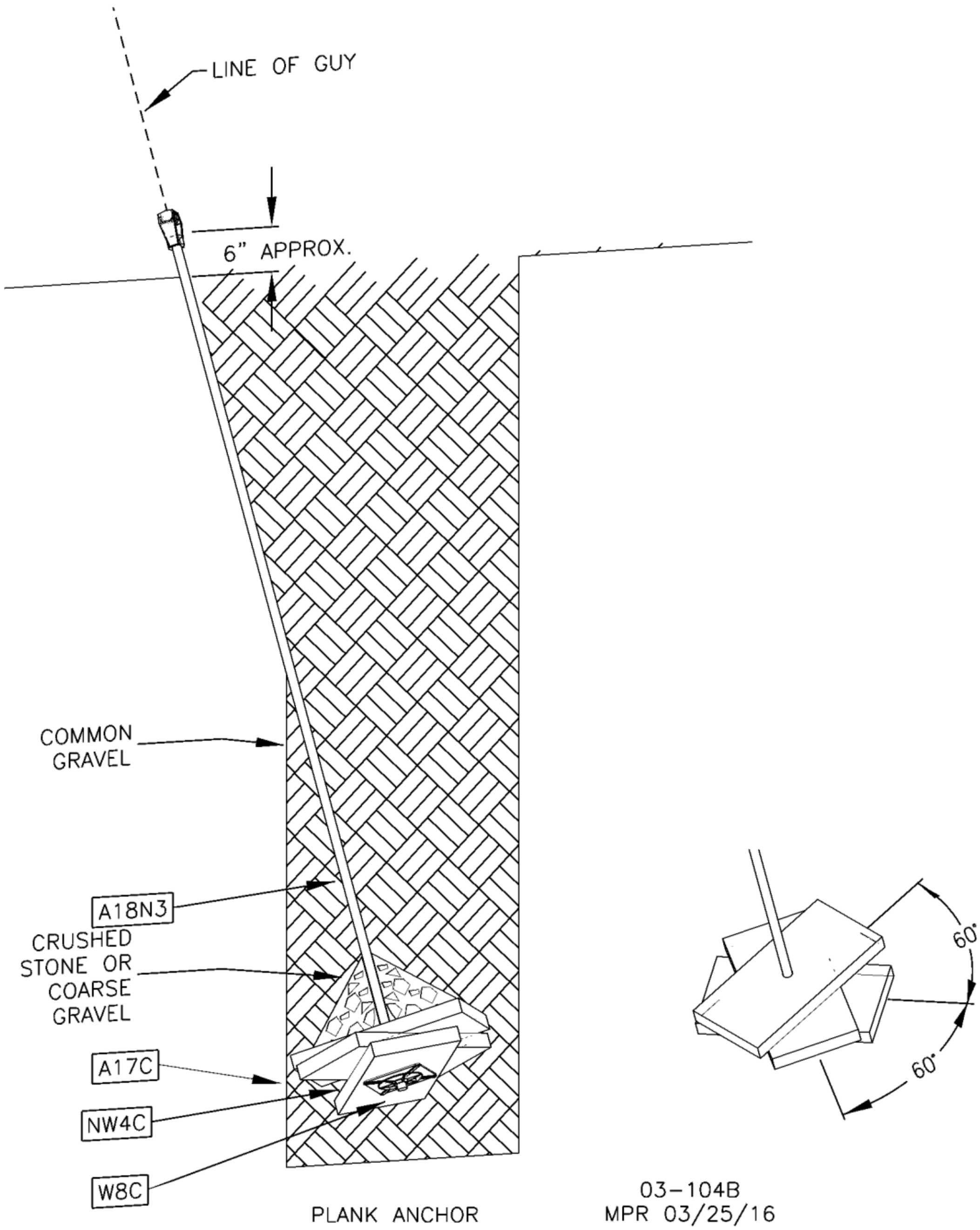
Figure 2

Supersedes 1/07 Issue – Added CU note.

Installation Procedure

A. Dig hole a minimum 5½ feet deep.
B. Cut channel for rod to line up with guy.
C. Scrape loose earth to far corner of bottom of hole to square with bottom of anchor.
D. Attach 14" Helix (A16B) to 1" x 7' Rod (A18K).
E. Fit anchor assembly in hole.
F. Line up anchor rod with slope of guy (upper guy when two guys are attached).
G. Tamp crushed stone or coarse gravel between face of anchor and undisturbed earth. Fill void completely.
H. Backfill all earth removed - thoroughly tamping by layers.

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission, and Sub-transmission with distribution accounting.

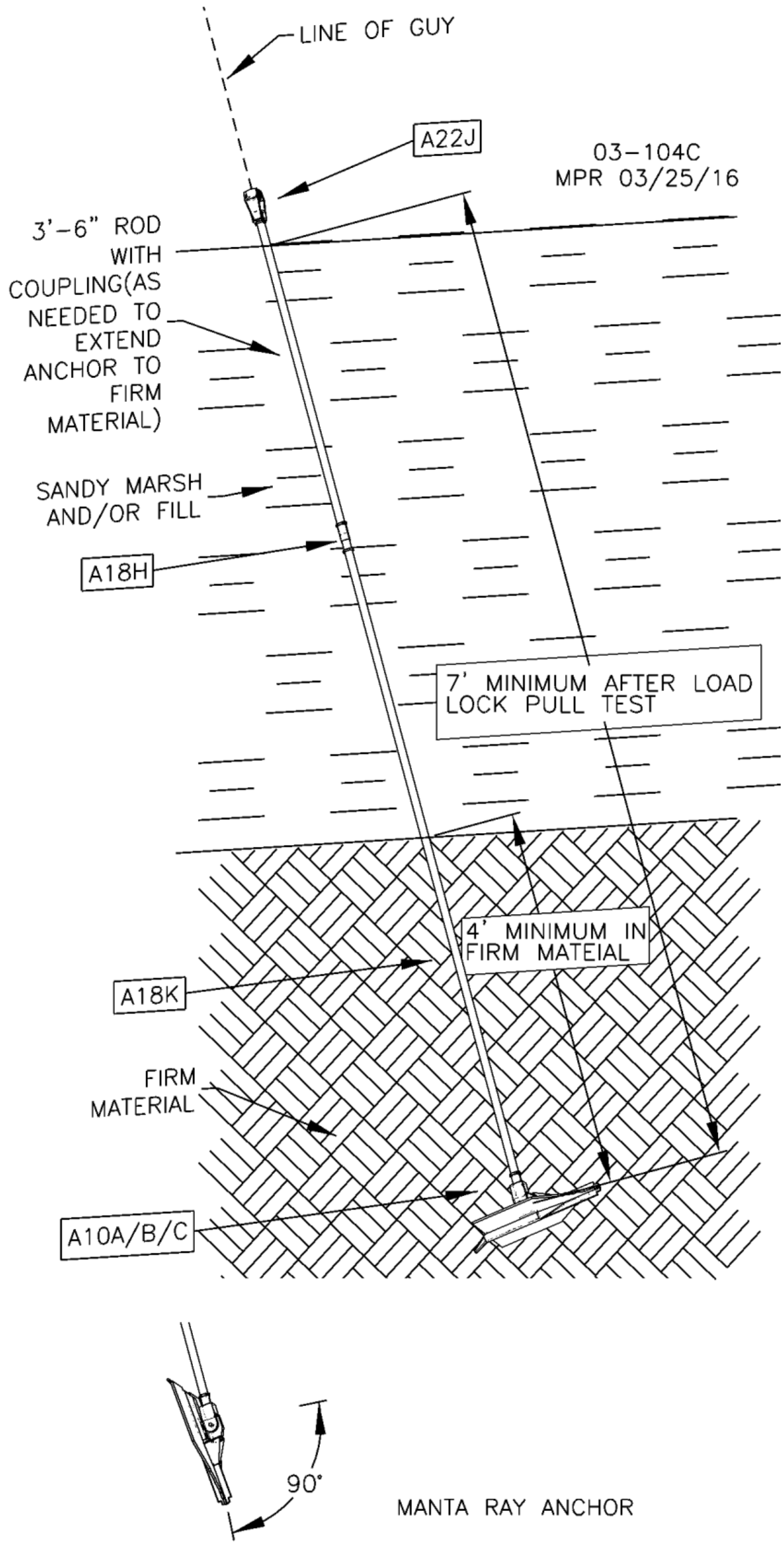


7/16 – New issue.

Notes:

1. Anchors shall be installed so that the anchor rod aligns with the guy wire with a tolerance of +/- 5-degrees. Where multiple guy wires use the same anchor, the rod shall align with the highest guy wire.
2. Individual anchors shall be separated by a minimum of 4-feet.
3. Anchors shall be installed by first excavating a hole to the required depth. A rod trench shall then be dug which allows the anchor rod to rest in alignment with the guy wire. The trench shall be as narrow as possible.
4. The rod and anchor assembly shall be placed in the trench and adjusted to align with the guy wire. The hole shall then be back filled and machine tamped in 6-inch layers to final grade.

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission, and Sub-transmission with distribution accounting.



Notes:

1. Use anchor A10A for soft soil conditions, A10B for medium density soil and A10C for high density soil. See table 3, pp 3-6.
2. Anchors shall be installed so that the anchor rod aligns with the guy wire with a tolerance of +/- 5-degrees. Where multiple guy wires use the same anchor, the rod shall align with the highest guy wire.
3. Individual anchors shall be separated from each other by a minimum of 4-feet.
4. The assembled anchor head and rod shall be driven suing the drive steel in alignment with the guy wire.
5. The anchor shall be driven to a minimum initial embedment of 10-feet. If soft material is encountered, driving shall continue until the anchor has achieved a minimum of 4-feet into firm material. Additional rods shall be coupled to the driven rod as needed to achieve the required embedment depth.
6. The anchor shall be load locked and proof tested using the load locker LL-1. Anchors shall be proof tested to 90% of the specified load.
7. The anchor shall be rejected if it fails the proof test or if the final embedment after proof testing is less than 7-feet measure along the length of the rod.

7/16 – New Issue.

CU = GUY-3-105,12.5MDWNG/TI95B	GROUNDED 12.5M GUY - WYE PRIMARY (FIG #1)
CU = GUY-3-105,12.5MDWN2-TI95B	INSULATED 12.5M GUY - DELTA PRIMARY (FIG #2)

Figure 1 - **Primary Guy for WYE Circuits**

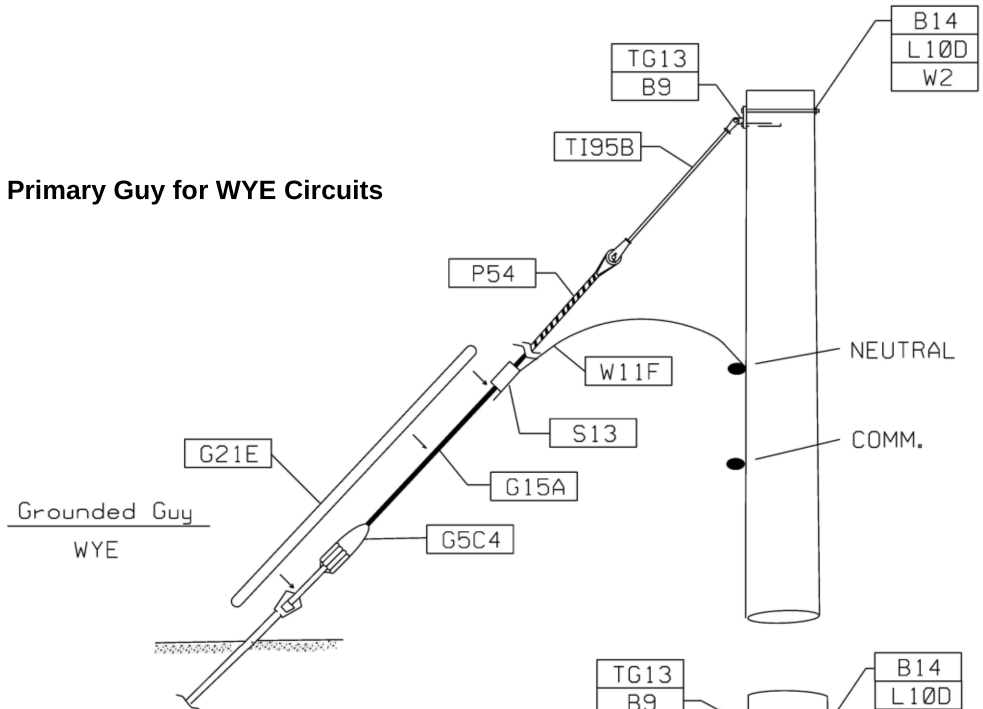
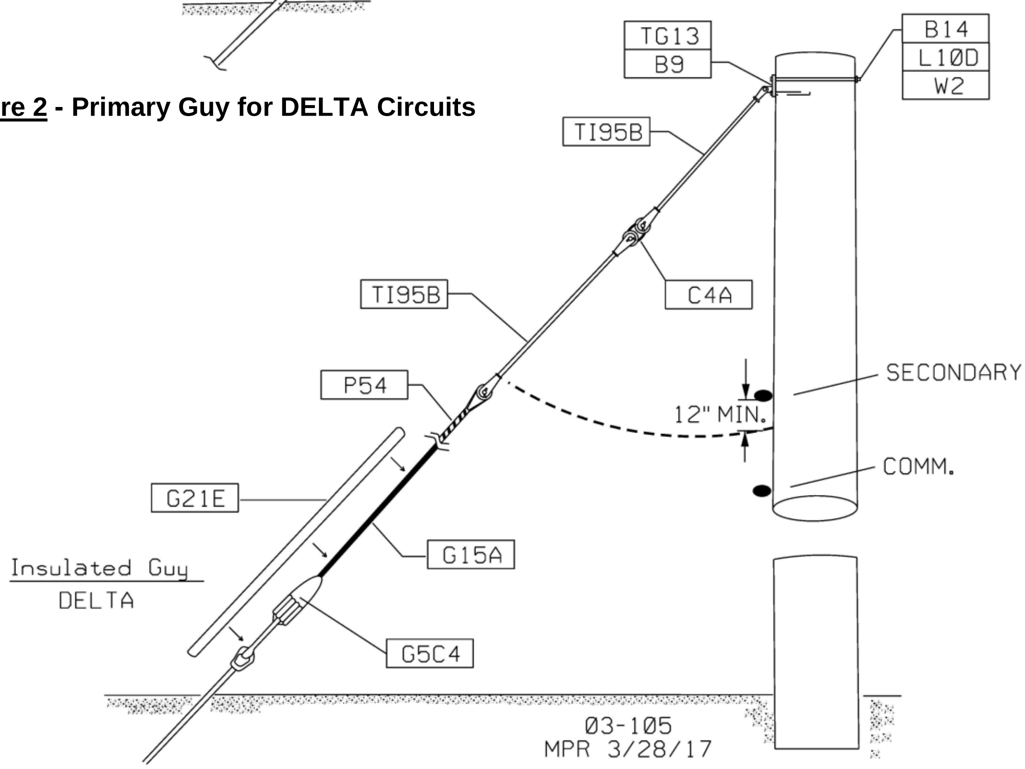


Figure 2 - **Primary Guy for DELTA Circuits**



Supersedes 7/6 Issue – Change W1 to W2, add L10D-Fig 1, Fig2.

NOTE: If the lower fiberglass rod does not extend a minimum of 12” below the secondary attachment if the guy were slack against the pole, additional fiberglass rods shall be used (applies to delta circuits).

Guy hook TG13 requires 1, ¾” diameter through bolt (upper hole position) and 2, 4” x ½” diameter lag screws (lower hole positions).

CU = GUY-3-106,25MDOWN	GROUNDED 25M GUY - WYE PRIMARY (FIG #1)
CU = GUY-3-106,25MDWN2-TI95C	INSULATED 25M GUY - DELTA PRIMARY (FIG #2)

Supersedes 7/10 Issue – Added 8' -0" minimum spacing to ground requirement. Added L10D Fig 1 and 2.

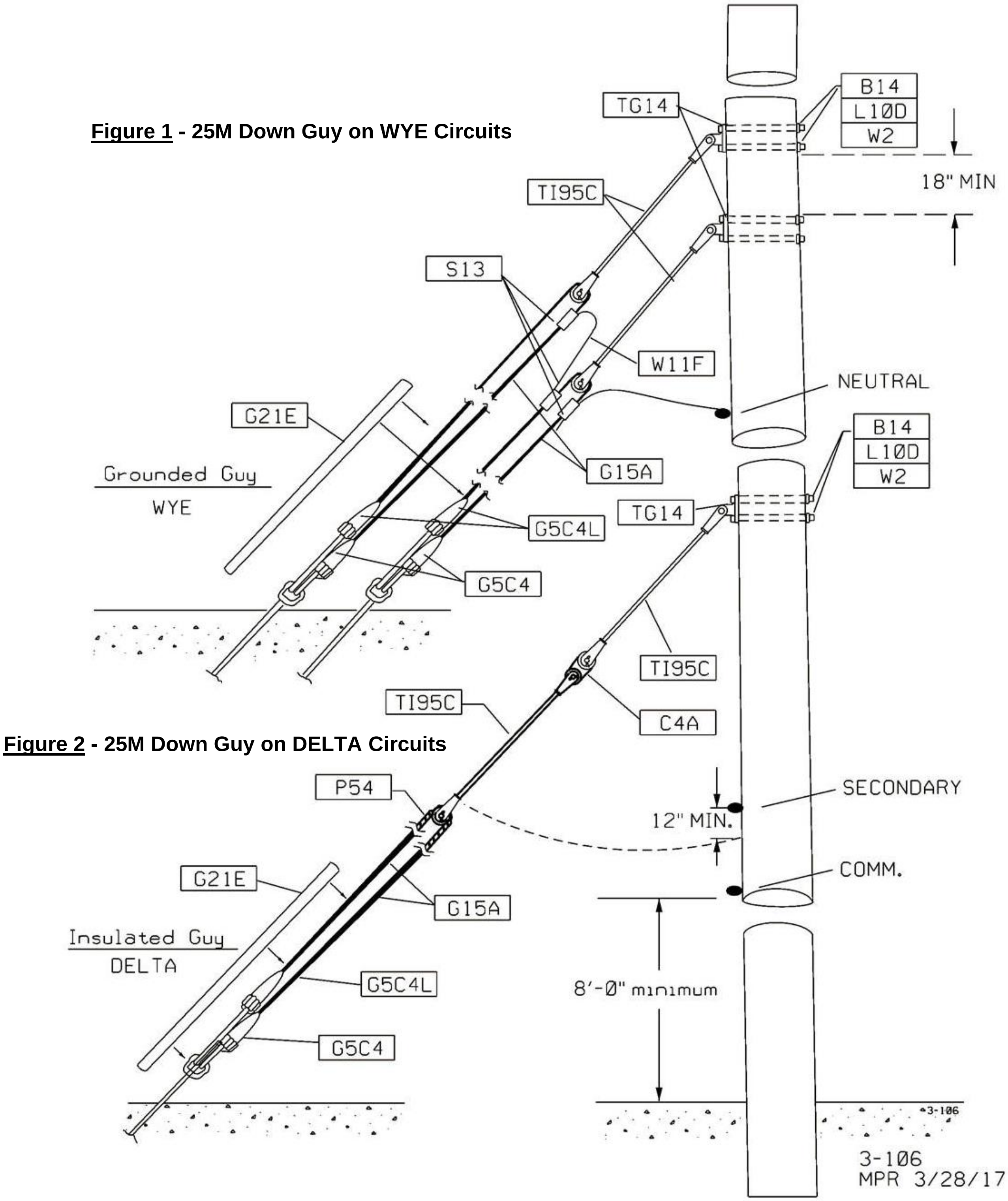


Figure 1 - 25M Down Guy on WYE Circuits

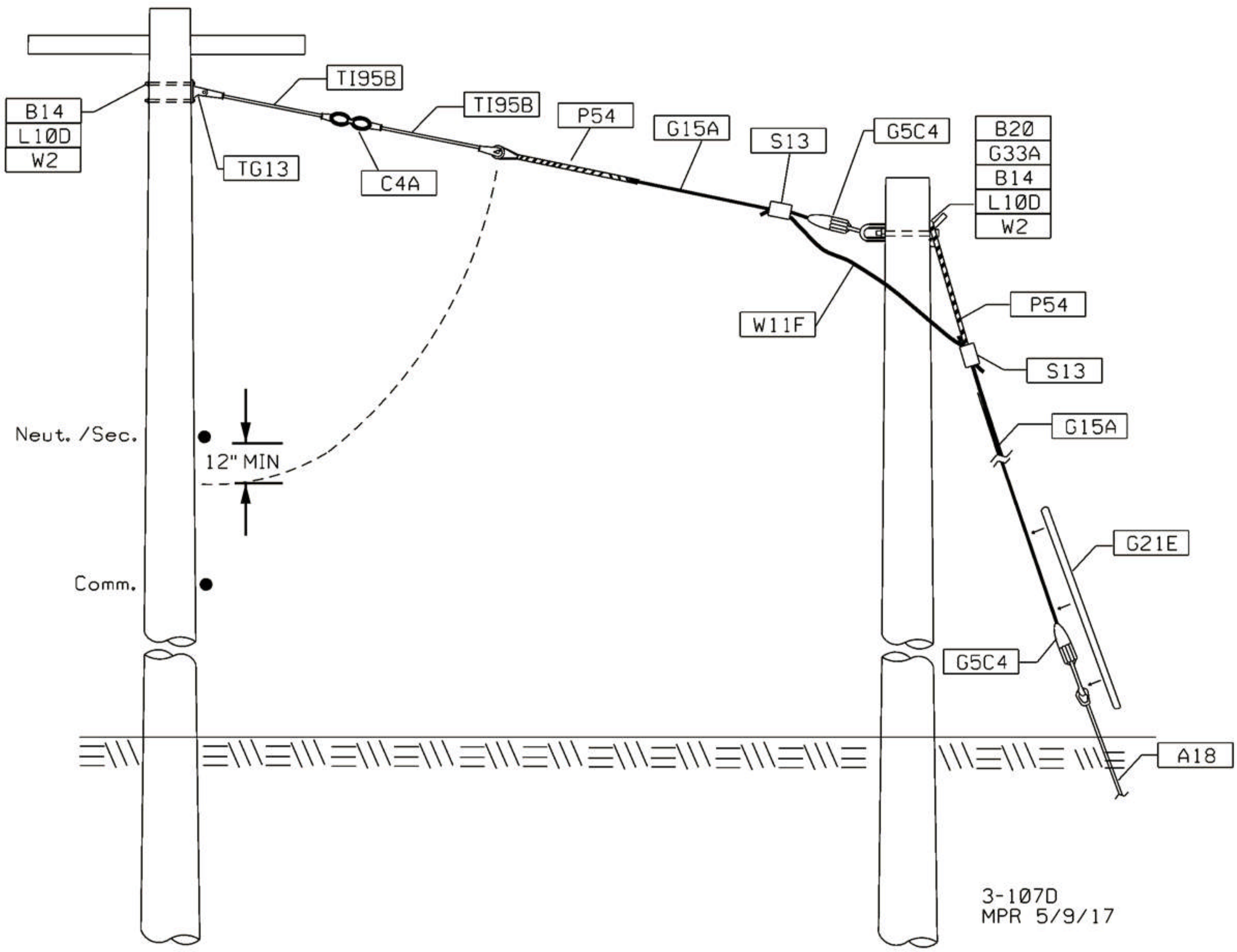
Figure 2 - 25M Down Guy on DELTA Circuits

NOTE 1: If the lower fiberglass rod does not extend a minimum of 12" below the secondary attachment if the guy were slack against the pole, additional fiberglass rods shall be used (applies to delta circuits).

NOTE 2: Adjacent anchors to have a 4 foot minimum separation (for both wye and delta circuits).

CU = GUY-3-107D,12.5MSPANPRIDP	GUY,12.5M SPAN GUY- DELTA PRIMARY	(SPAN GUY COMPONENTS ONLY)
CU = GUY-3-107D,12.5MDWNNOINS	GUY,12.5M DOWN NO INSUL- STUB POLE	(ANCHORED DOWN GUY WIRE)

CU = GUY-G15A,WIRE12.5M	GUY, G15A, WIRE 12.5M ALUMO-WELD	(GUY WIRE ONLY)



Supersedes 7/10 Issue – Added L10D two places.

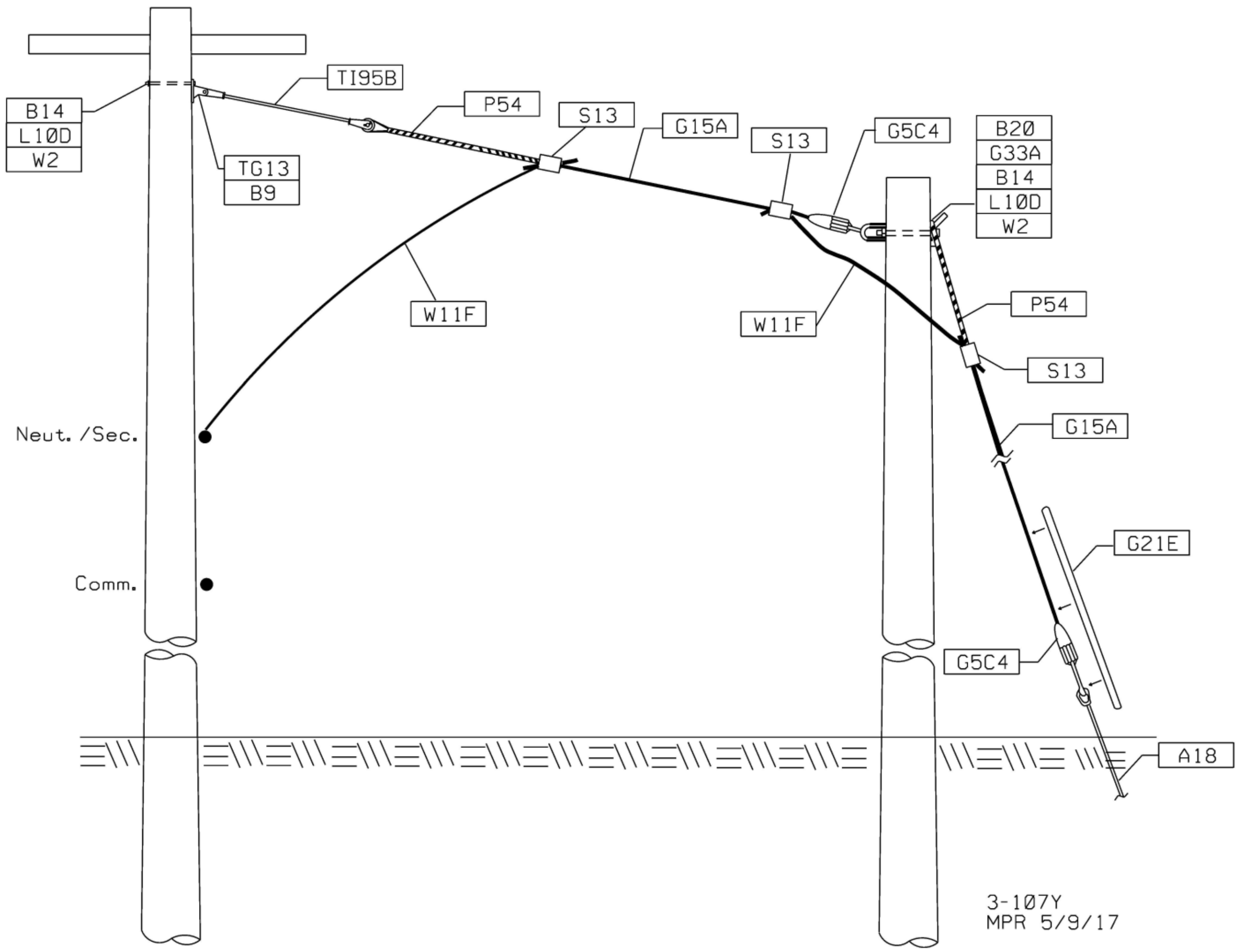
NOTE 1: If the lower fiberglass rod does not extend a minimum of 12" below the secondary attachment if the guy were slack against the pole, additional fiberglass rods shall be used.

NOTE 2: It is acceptable to use the tail of the stub pole guy wire as a bond to the pole-to-pole guy wire, or vice versa. Otherwise, a piece of #4 solid copper wire should be used as a bond wire as shown in the drawing above. DO NOT bond to the preform or the bail of the automatic. These connections must be wire to wire and a compression connector must be used.

CU = GUY-3-107Y,12.5MSPANPRIYP	GUY,12.5M SPAN GUY- WYE PRIMARY	(SPAN GUY COMPONENTS ONLY)
CU = GUY-3-107Y,12.5MDWNGNOINS	GUY,12.5M DOWN GROUNDED NO INSUL- STUB POLE	(ANCHORED DOWN GUY WIRE)

CU = GUY-G15A,WIRE12.5M	GUY, G15A, WIRE 12.5M ALUMO-WELD	(GUY WIRE ONLY)

Supersedes 7/10 Issue – Add L10D two places.

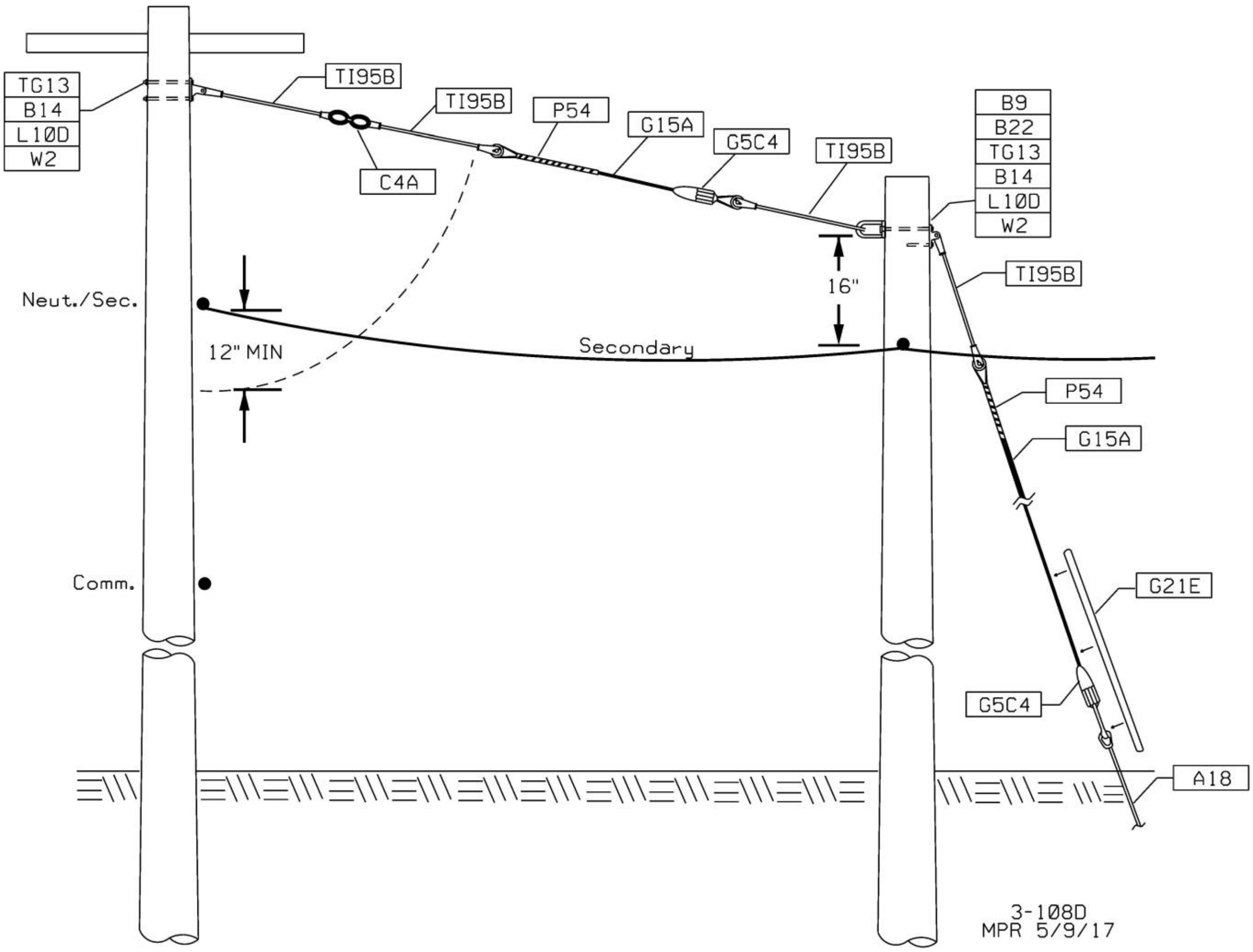


NOTE: It is acceptable to use the tail of the stub pole guy wire as a bond to the pole-to-pole guy wire, or vice versa. Otherwise, a piece of #4 solid copper wire should be used as a bond wire as shown in the drawing above. DO NOT bond to the preform or the bail of the automatic. These connections must be wire to wire and a compression connector must be used.

STUB POLE GUY - WYE CIRCUIT			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 3-107Y	ISSUE 7/17

CU = GUY-3-108D,12.5MSPANSECDP	GUY,12.5M SPAN GUY, W/SEC - DELTA PRIMARY	(SPAN GUY COMPONENTS ONLY)
CU = GUY-3-108D,12.5MDWNW/INS	GUY,12.5M DOWN W /INSUL - STUB POLE	(ANCHORED DOWN GUY WIRE)

CU = GUY-G15A,WIRE12.5M	GUY, G15A, WIRE 12.5M ALUMO-WELD	(GUY WIRE ONLY)



Supersedes 7/16 Issue – Add L10D two places.

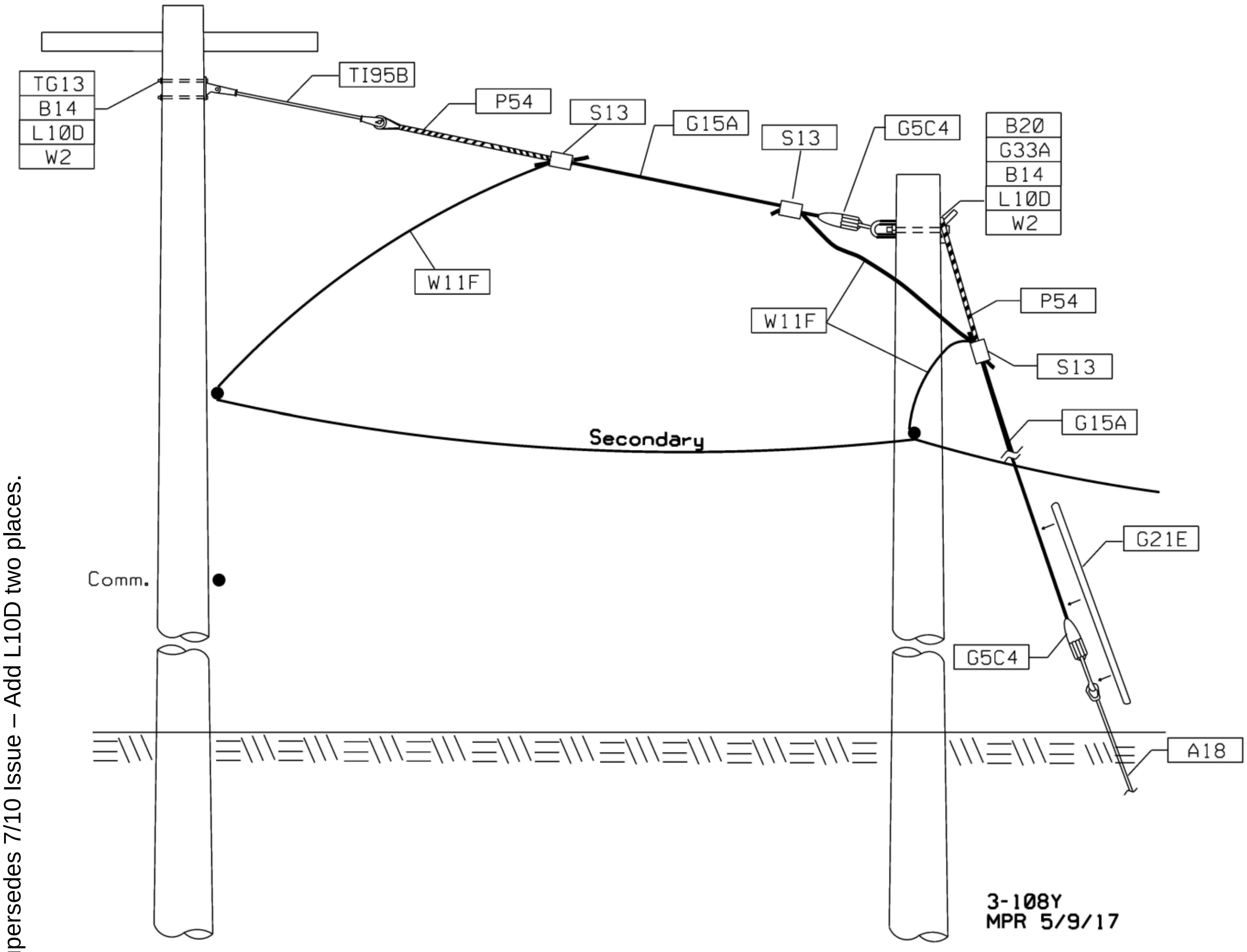
NOTE: If the lower fiberglass rod does not extend a minimum of 12” below the secondary attachment if the guy were slack against the pole, additional fiberglass rods shall be used.

Guy hook TG13 on the pole side requires 2, ¾” diameter through bolts. Guy hook TG13 on the stub pole requires 1, ¾” diameter through bolt (upper hole position) and 2, 4” x ½” diameter lag screws (lower hole positions).

CU = GUY-3-108Y,12.5MSPANSECYP	GUY, 12.5M SPAN GUY, W/SEC - WYE PRIMARY	(SPAN GUY COMPONENTS ONLY)
CU = GUY-3-108Y,12.5MDWNGNOINS	GUY, 12.5M DOWN GROUNDED NO INSUL- STUB POLE	(ANCHORED DOWN GUY WIRE)

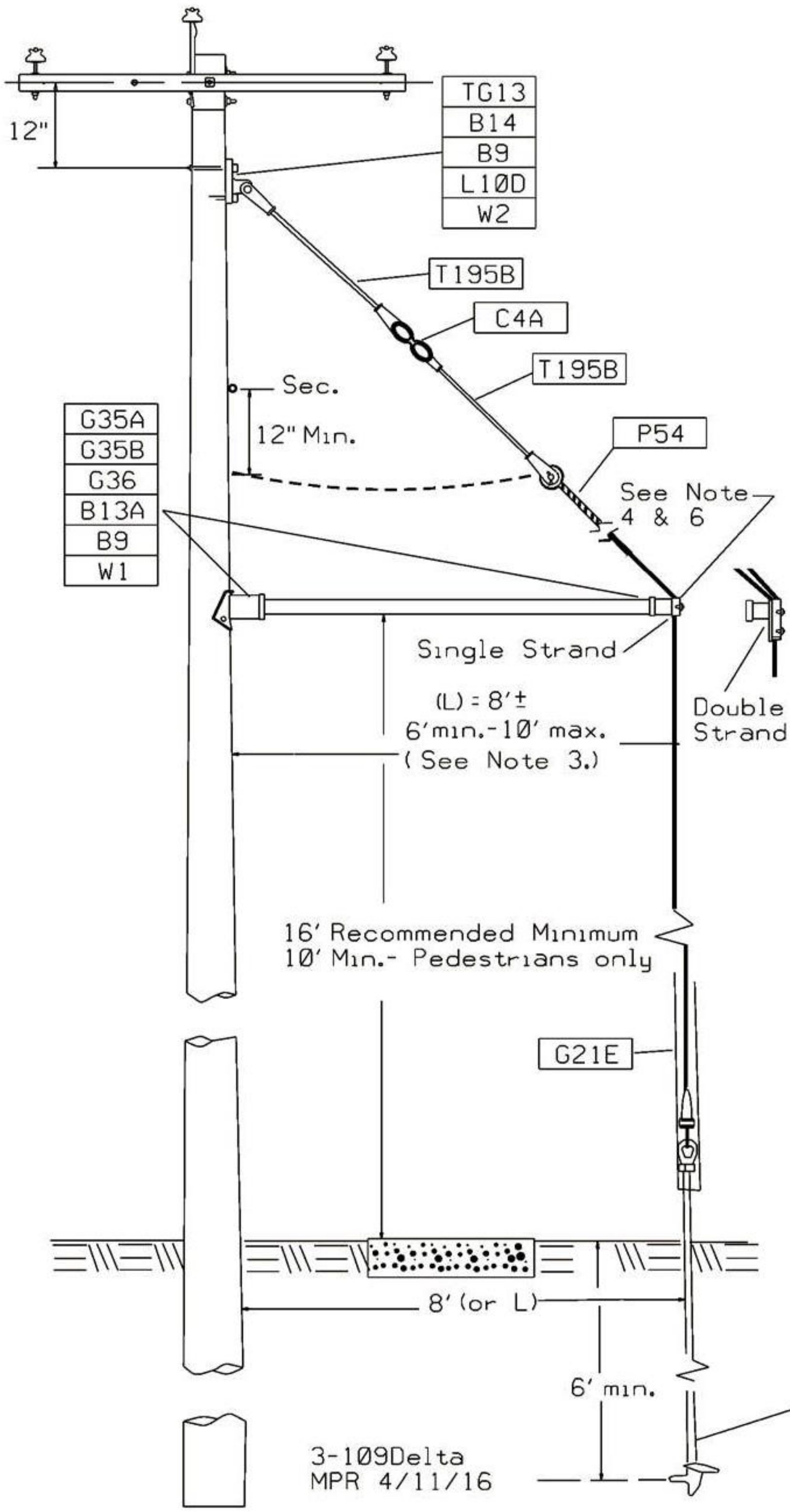
CU = GUY-G15A,WIRE 12.5M	GUY, G15A, WIRE 12.5M ALUMO-WELD	(GUY WIRE ONLY)

Supersedes 7/10 Issue – Add L10D two places.



NOTE: It is acceptable to use the tail of the stub pole guy wire as a bond to the pole-to-pole guy wire, or vice versa. Otherwise, a piece of #4 solid copper wire should be used as a bond wire as shown in the drawing above. DO NOT bond to the preform or the bail of the automatic. These connections must be wire to wire and a compression connector must be used.

CU = GUY-3-109D,12.5MSTRUT	12.5M STRUT GUY - DELTA PRIMARY
CU = GUY-3-109D,25MSTRUT	25M STRUT GUY - DELTA PRIMARY

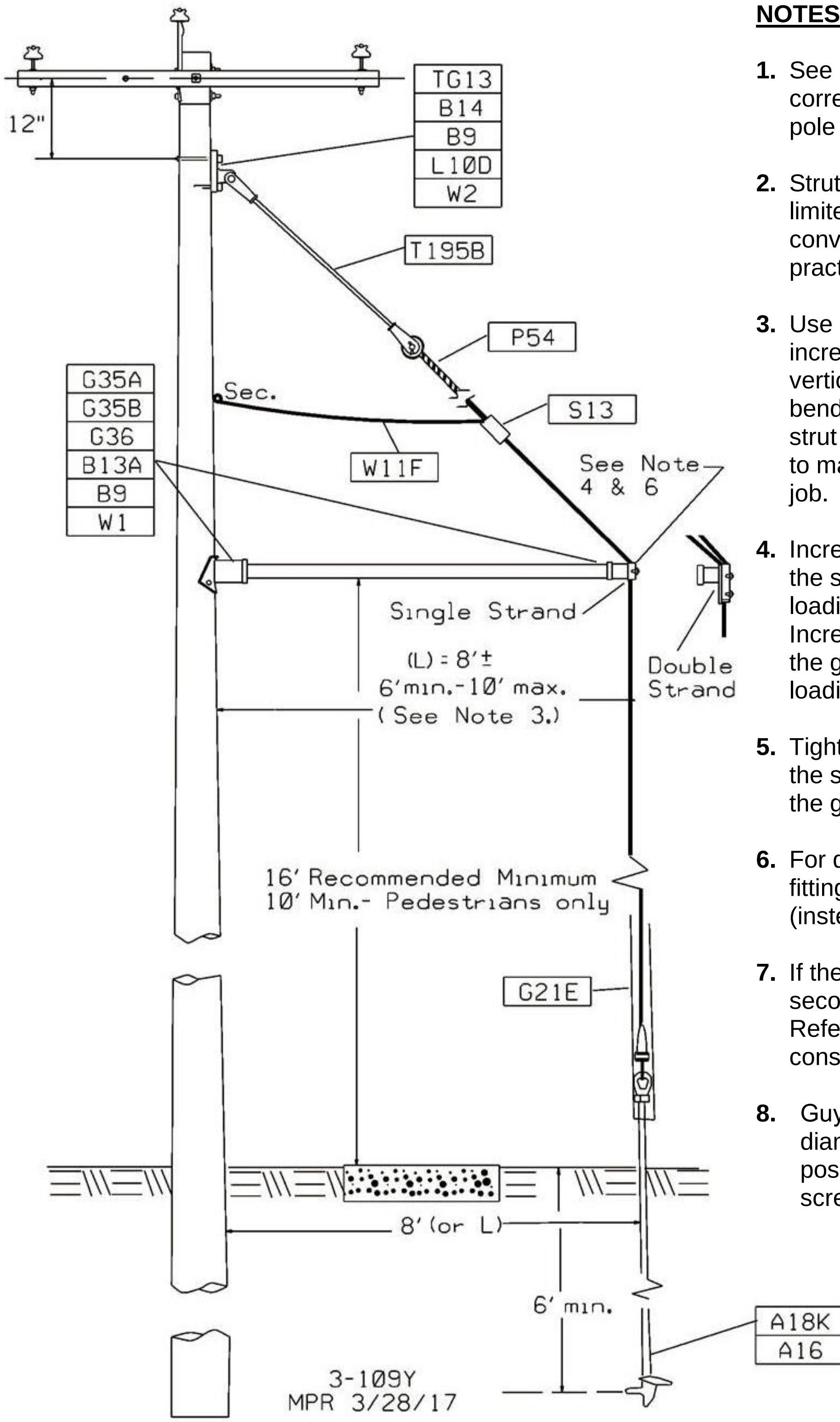


NOTES:

1. See Example #3 to determine the correct guy strand & strut size and pole class.
2. Strut guys shall be used only for limited pole loadings and where conventional guying methods are not practical.
3. Use of strut guys significantly increases guy strand tension and vertical pole load and introduces bending stress to the pole. If a 10' strut is needed, engineering will need to manually add item UK30D to the job.
4. Increasing the height above grade of the strut increases the lateral pole loading and increases guy tension. Increasing the strut length decreases the guy tension and vertical pole loading.
5. Tighten the end of the guy strand into the strut end-clamp before tensioning the guy.
6. For double guy strands, use sidewalk fitting G35C with guy clamp G7B (instead of G35B).
7. If the lower fiberglass rod does not extend a minimum of 12" below the secondary attachment if the guy were slack against the pole, additional fiberglass rods shall be used.
8. Guy hook TG13 requires 1, ¾" diameter through bolt (upper hole position) and 2, 4" x ½" diameter lag screws (lower hole positions).

Supersedes 7/16 Issue – Added L10D.

CU = GUY-3-109Y,12.5MSTRUT	12.5M STRUT GUY- WYE PRIMARY
CU = GUY-3-109Y,25MSTRUT	25M STRUT GUY - WYE PRIMARY



Supersedes 7/16 Issue – Added L10D.

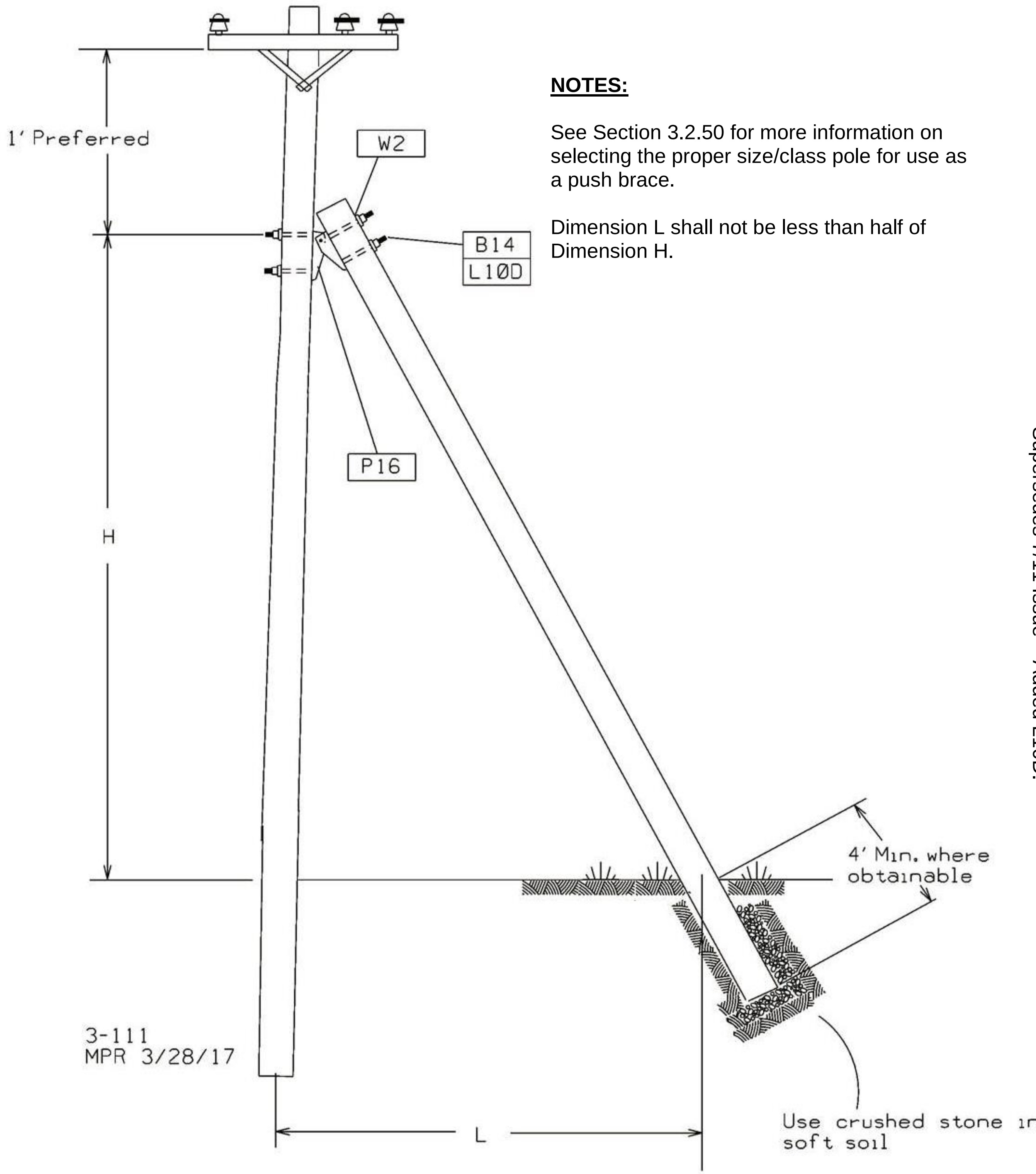
NOTES:

1. See Example #3 to determine the correct guy strand & strut size and pole class.
2. Strut guys shall be used only for limited pole loadings and where conventional guying methods are not practical.
3. Use of strut guys significantly increases guy strand tension and vertical pole load and introduces bending stress to the pole. If a 10' strut is needed, engineering will need to manually add item UK30D to the job.
4. Increasing the height above grade of the strut increases the lateral pole loading and increases guy tension. Increasing the strut length decreases the guy tension and vertical pole loading.
5. Tighten the end of the guy strand into the strut end-clamp before tensioning the guy.
6. For double guy strands, use sidewalk fitting G35C with guy clamp G7B (instead of G35B).
7. If the guy wire is not bonded, a second fiberglass rod is required. Refer to Drawing 3-109D for construction details.
8. Guy hook TG13 requires 1, ¾" diameter through bolt (upper hole position) and 2, 4" x ½" diameter lag screws (lower hole positions).

SIDEWALK/STRUT GUY - WYE CIRCUIT

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	**3-109Y**	**7/17**

CU = PBR-3-111,(XX)'CLASS(Y)	PUSH BRACE – (XX) = POLE SIZE, (Y) = POLE CLASS
CU = PBR-3-111,(XX)'CLASS(Y)JO	PUSH BRACE –(XX) = POLE SIZE, (Y) = POLE CLASS – TEL SET



NOTES:

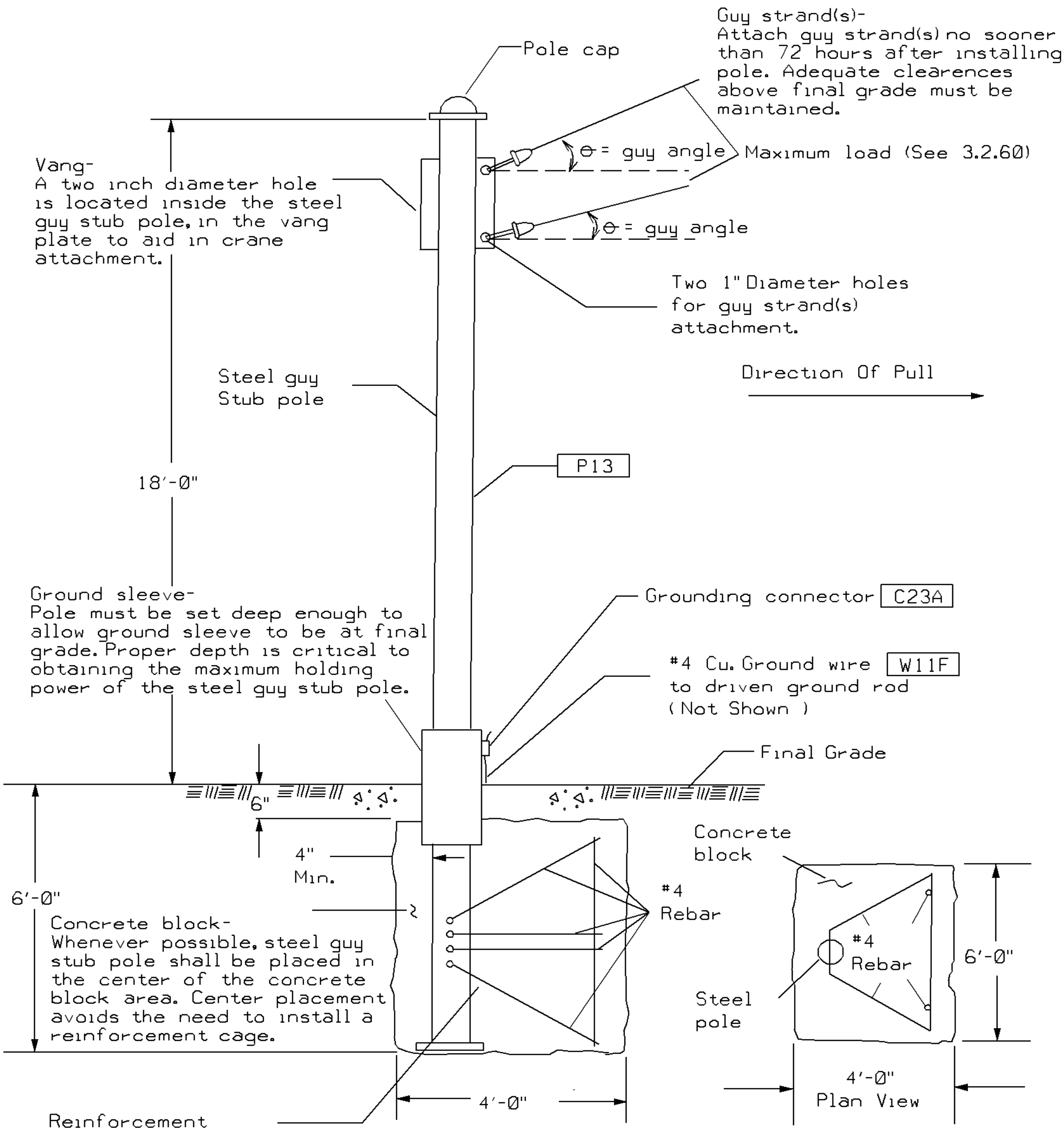
See Section 3.2.50 for more information on selecting the proper size/class pole for use as a push brace.

Dimension L shall not be less than half of Dimension H.

Supersedes 7/11 Issue – Added L10D.

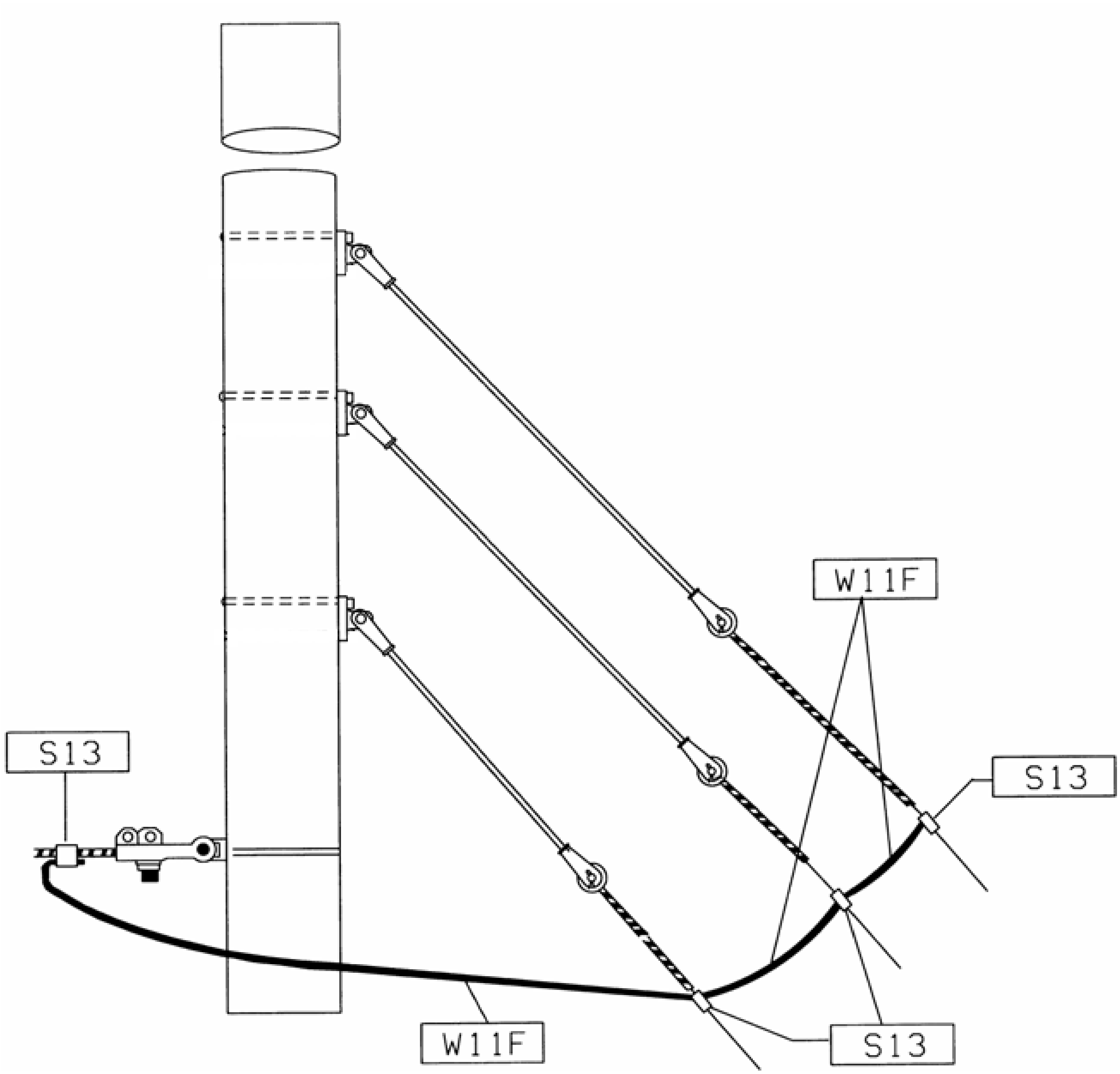
CU = ANC-3-112,STLGUYSTUBPOLE	STEEL GUY STUB

Supersedes 7/09 Issue – Page shift due to other updates.



Reinforcement cage-
In cases where center placement is not practical, the steel guy stub pole may be placed anywhere within the concrete block, but in no case closer than 4 inches from an outside edge. Off center placement requires the installation of a reinforcement cage, as shown Figure 1, in order to engage the mass of concrete in holding the steel guy stub pole. Reinforcement cage shall consist of four horizontal members, each one, #4 rebar formed into a triangle, held in place vertically by two # 4 rebars.

CU = GUY-3-114,BONDGUY	BONDING GUY



Supersedes 1/06 Issue – Updated CU.

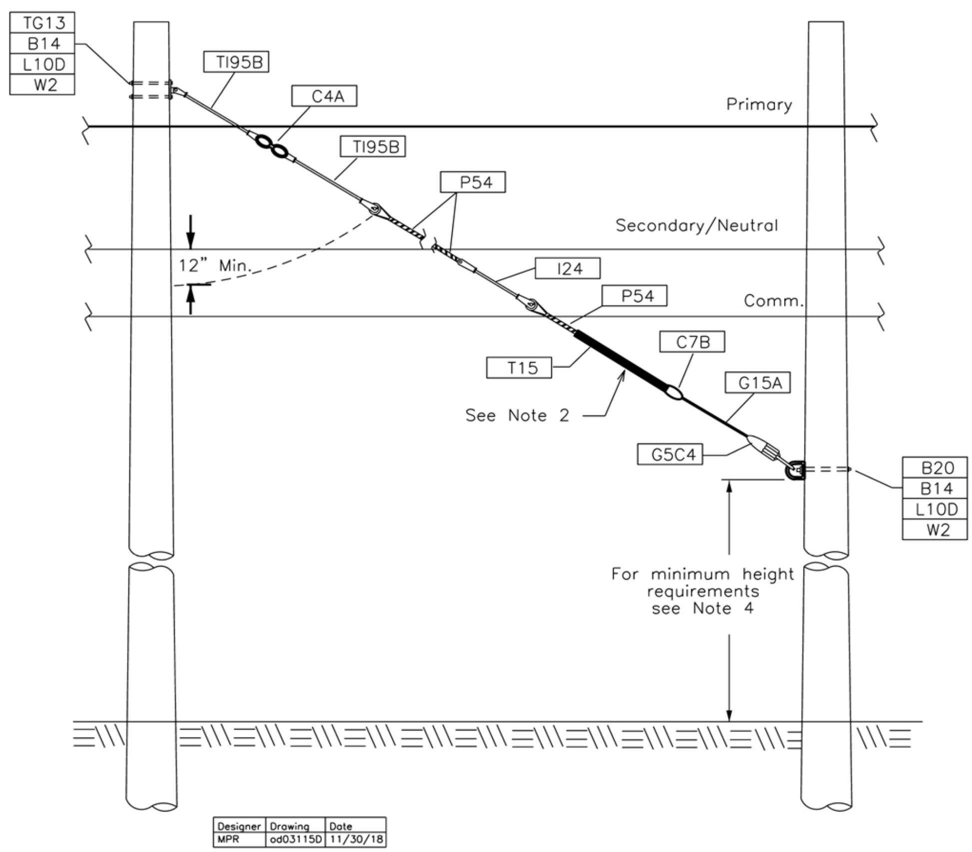
BONDING GUYS

ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/09	3-114		

CU = GUY-3-115D,12.5MPOLE-POLE	GUY,12.5M POLE TO POLE - DELTA PRIMARY	(SPAN GUY COMPONENTS ONLY)

CU = GUY-G15A,WIRE12.5M	GUY, G15A, WIRE 12.5M ALUMO-WELD	(GUY WIRE ONLY)

Supersedes 7/19 Issue – Update note 6.

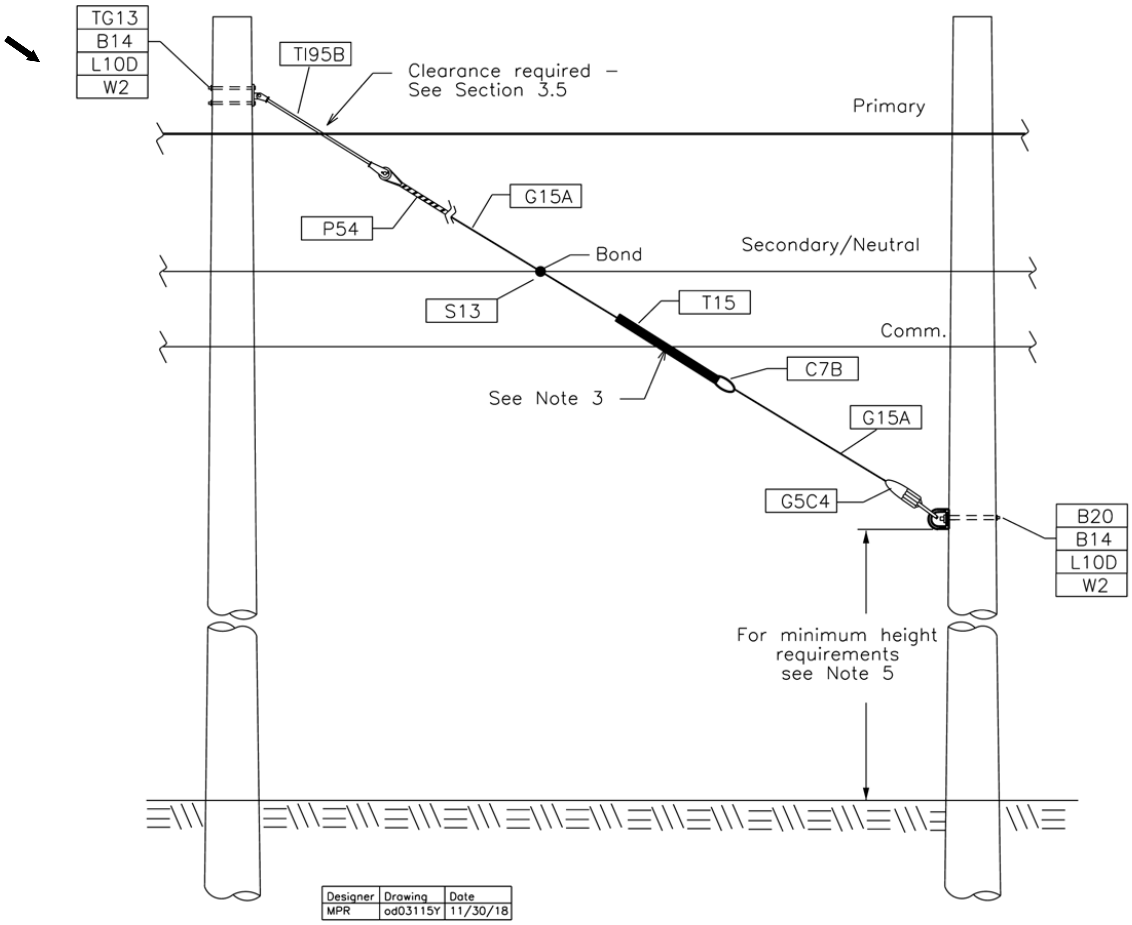


NOTES:

1. Always use a minimum of two fiberglass rods (54" minimum length) at the top of the guy where it is attached near the primary wires. If the lower fiberglass rod does not extend a minimum of 12" past the secondary if the guy were slack against the pole, additional fiberglass rods shall be installed. Install one fiberglass rod (12" minimum length) placed in the guy wire so that it sits between the secondary and communication cables.
2. Per the NESC, 6" of clearance is required between the guy wire and any communication cables. This clearance may be reduced to no less than 3" if abrasion protection (Std Item T15) is added to the guy wire.
3. The pole to pole guy wire must be installed with the minimum clearances to primary conductors shown in the table in Section 3.5. For most installations, this will require off-setting the center phase from a pole top pin to a crossarm, even if the guy wire is attached to the pole below the primary conductor. Refer to Figure 8 in Section 3.5 for more information.
4. A minimum clearance of 15' 6" is required if the guy wire is above driveways, parking lots, alleys, and other land possibly traversed by vehicles that are more than 8' in height or by riders on horses or other large animals. If spaces and ways are subject to pedestrian or restricted traffic only (areas where riders on horses or other large animals, vehicles, or other mobile units exceeding a total height of 8' are prohibited by regulation or permanent terrain configurations), a minimum height of 9' 6" may be used (NESC Rule 232B, Table 232-1).
5. If the lower end of the guy wire is attached above all communication attachments, the 12" fiberglass rod (I24) is not needed.
6. If installing a span guy on pole with no primary wires, all secondary and communication clearances, assembly hardware, and bonding shown in the figure above are required.

CU = GUY-3-115Y,12.5MPOLE-POLE	GUY,12.5M POLE TO POLE – WYE PRIMARY	(SPAN GUY COMPONENTS ONLY)

CU = GUY-G15A,WIRE,12.5M	GUY, G15A, WIRE 12.5M ALUMO-WELD	(GUY WIRE ONLY)



Supersedes 7/19 Issue – Update note 6.

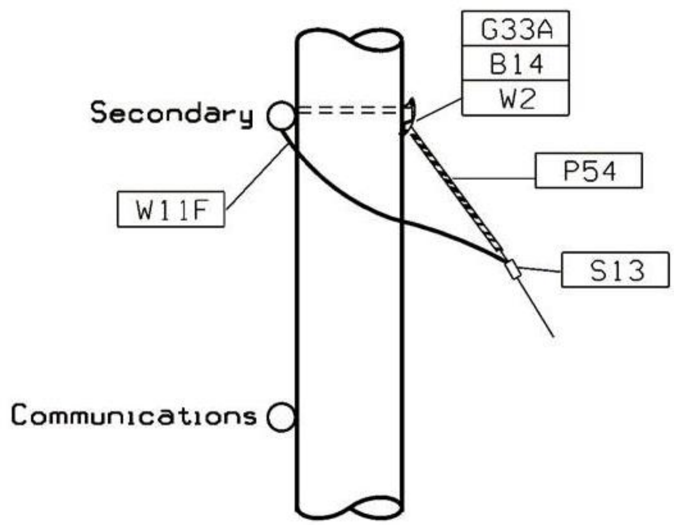
NOTES:

1. Always use a minimum of one fiberglass rod (54" length minimum) at the top of the guy where it is attached near the primary wires.
2. Bond the guy wire to the neutral as the guy wire passes the secondary cable using a compression connector.
3. Per the NESC, 6" of clearance is required between the guy wire and any communication cables. This clearance may be reduced to no less than 3" if abrasion protection (Std Item T15) is added to the guy wire.
4. The pole to pole guy wire must be installed with the minimum clearances to primary conductors shown in the table in Section 3.5. For most installations, this will require off-setting the center phase from a pole top pin to a crossarm, even if the guy wire is attached to the pole below the primary conductor. Refer to Figure 8 in Section 3.5 for more information.
5. A minimum clearance of 15' 6" is required if the guy wire is above driveways, parking lots, alleys, and other land possibly traversed by vehicles that are more than 8' in height or by riders on horses or other large animals. If spaces and ways are subject to pedestrian or restricted traffic only (areas where riders on horses or other large animals, vehicles, or other mobile units exceeding a total height of 8' are prohibited by regulation or permanent terrain configurations), a minimum height of 9' 6" may be used (NESC Rule 232B, Table 232-1).
6. If installing a span guy on pole with no primary wires, all secondary and communication clearances, assembly hardware, and bonding shown in the figure above are required.

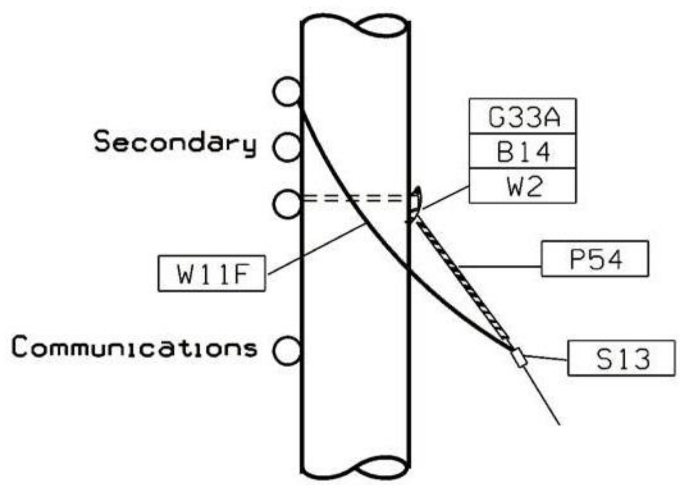
CU = GUY-3-118,12.5MDWNGSECYP	GUY, 12.5M DOWN GUY,SECONDARY - WYE PRIMARY

Supersedes 7/11 Issue – Added detail for open wire secondary and W2..

Wye - Secondary Triplex/Quadplex/Etc



Wye - Open Wire Secondary

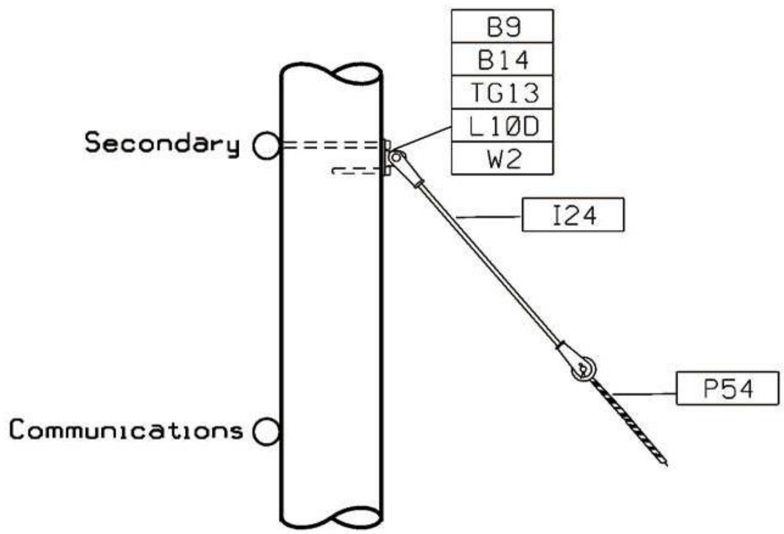


3-118
MPR 5/24/17

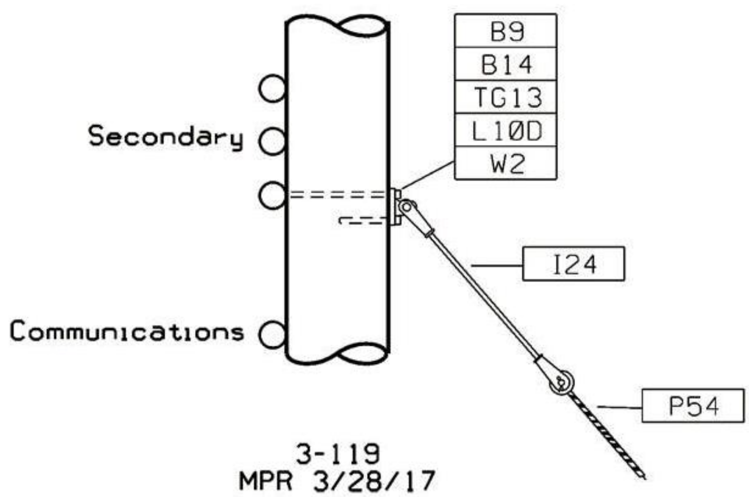
NOTE: For guy wire placement related to other secondary configurations on the pole, see Pages 10-100 and 10-101.

CU= GUY-3-119,12.5MDWNGSECD	GUY,12.5M DOWN GUY,SECONDARY- DELTA PRIMARY

Delta - Secondary Triplex/Quadplex/Etc



Delta - Open Wire Secondary



3-119
MPR 3/28/17

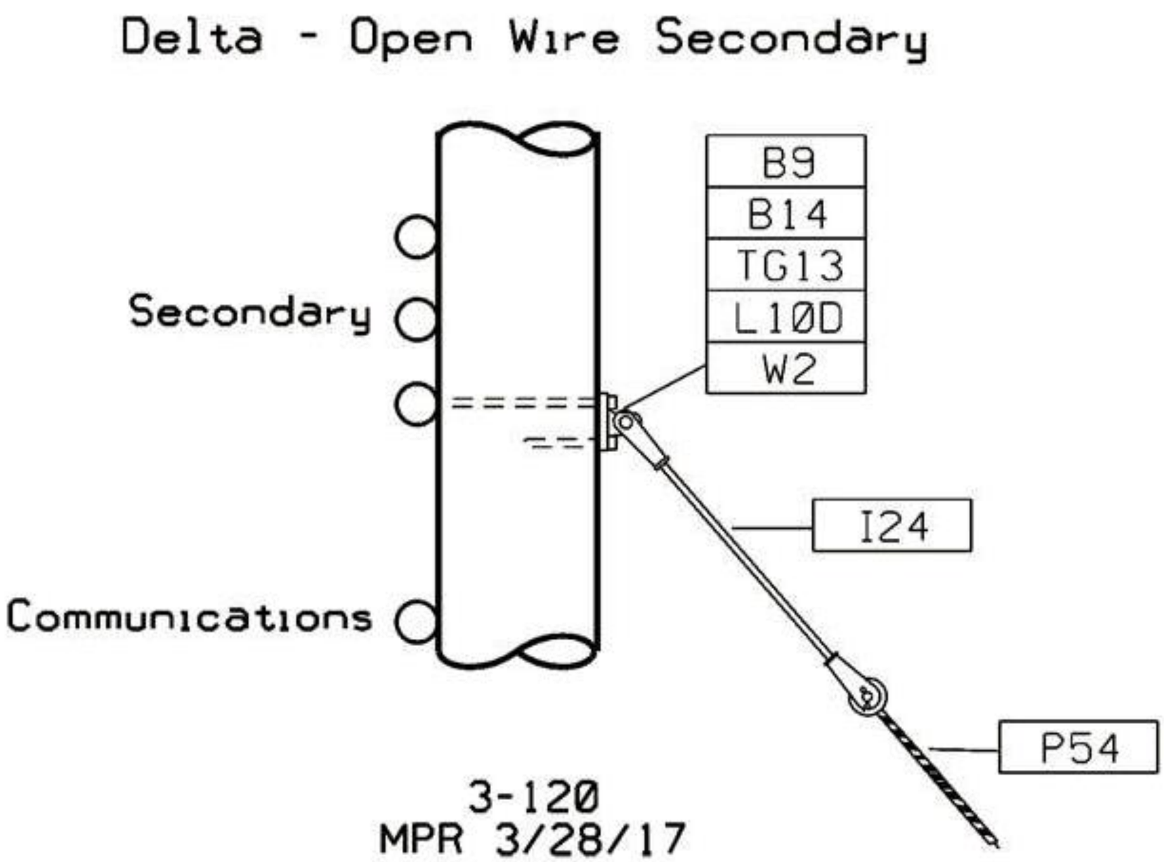
Supersedes 7/16 Issue – Add W2, add L10D 2 places.

<u>NOTE</u>: For guy wire placement related to other secondary configurations on the pole, see Pages 10-100 and 10-101.

Guy hook TG13 requires 1, ¾" diameter through bolt (upper hole position) and 2, 4" x ½" diameter lag screws (lower hole positions).

CU = GUY-3-120,12.5MDWNGSECOW	GUY, 12.5M DOWN GUY SECONDARY OPEN WIRE

Supersedes 7/16 Issue – Add W2, add L10D.



Note: Guy hook TG13 requires 1, ¾” diameter through bolt (upper hole position) and 2, 4” x ½” diameter lag screws (lower hole positions).

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission and Sub-transmission with distribution accounting.

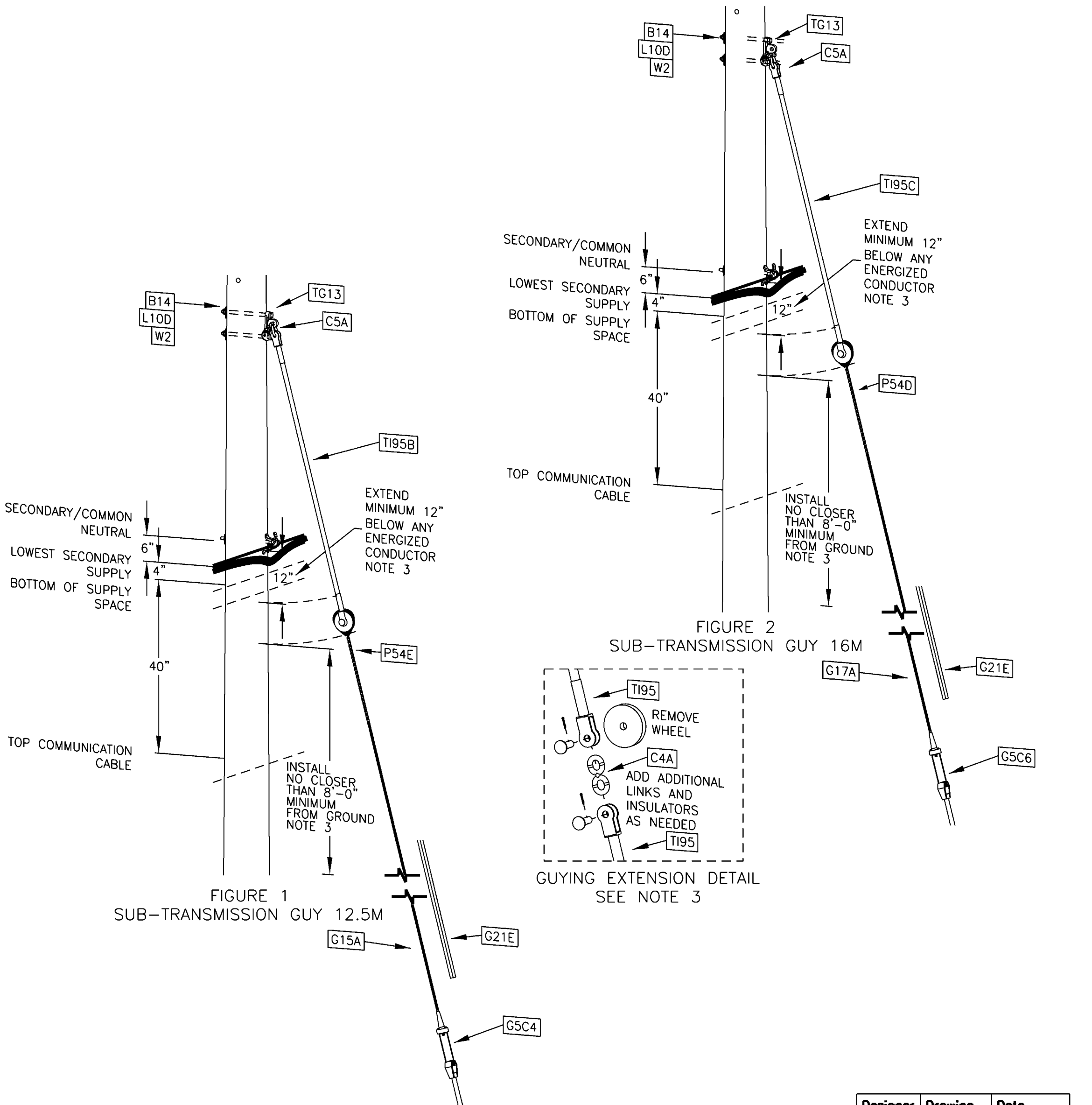


FIGURE 1
SUB-TRANSMISSION GUY 12.5M

FIGURE 2
SUB-TRANSMISSION GUY 16M

GUYING EXTENSION DETAIL
SEE NOTE 3

Designer	Drawing	Date
MPR	od3121	4/30/20

NOTE:
1. THESE GUY ASSEMBLIES ARE INTENDED FOR USE ON SUB-TRANSMISSION LINES.
2. GUY PLATE TG13 REQUIRES ONE, ¾" DIAMETER BOLT (B14) IN THE UPPER HOLE POSITION AND 2, ½" LAG BOLTS (B9) IN THE TWO LOWER HOLE POSITIONS FOR GUY LEADS AT 1:1 OR LESS (SHORTER). FOR GUY LEADS GREATER THAN 1:1 (LONGER), USE TWO, ¾" (B14) BOLTS IN THE TOP AND BOTTOM.
3. FIELD SHALL INSTALL ADDITIONAL GUY STRAIN INSULATORS (TI-95C) OR POSITION THE GUY STRAIN INSULATORS SUCH THAT IF THE GUY WIRE/SPAN GUY BECOMES BROKEN OR SLACK OR IF AN ENERGIZED CONDUCTOR BECOMES SLACK THE FOLLOWING SAFETY CONDITIONS MUST BE MET:
   A) ANY PART OF THE GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED DUE TO CONTACT WITH AN ENERGIZED CONDUCTOR SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   B) THE ENTIRE GUY STRAIN INSULATOR ATTACHED TO A GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   C) THE GUY STRAIN INSULATORS SHALL BE INSTALLED TO LIMIT THE LIKELIHOOD OF AN ANCHOR GUY BECOMING A CONDUCTIVE PATH BETWEEN AN ENERGIZED CONDUCTOR OR PART AND A CONDUCTOR OF ANOTHER CIRCUIT

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission and Sub-transmission with distribution accounting.

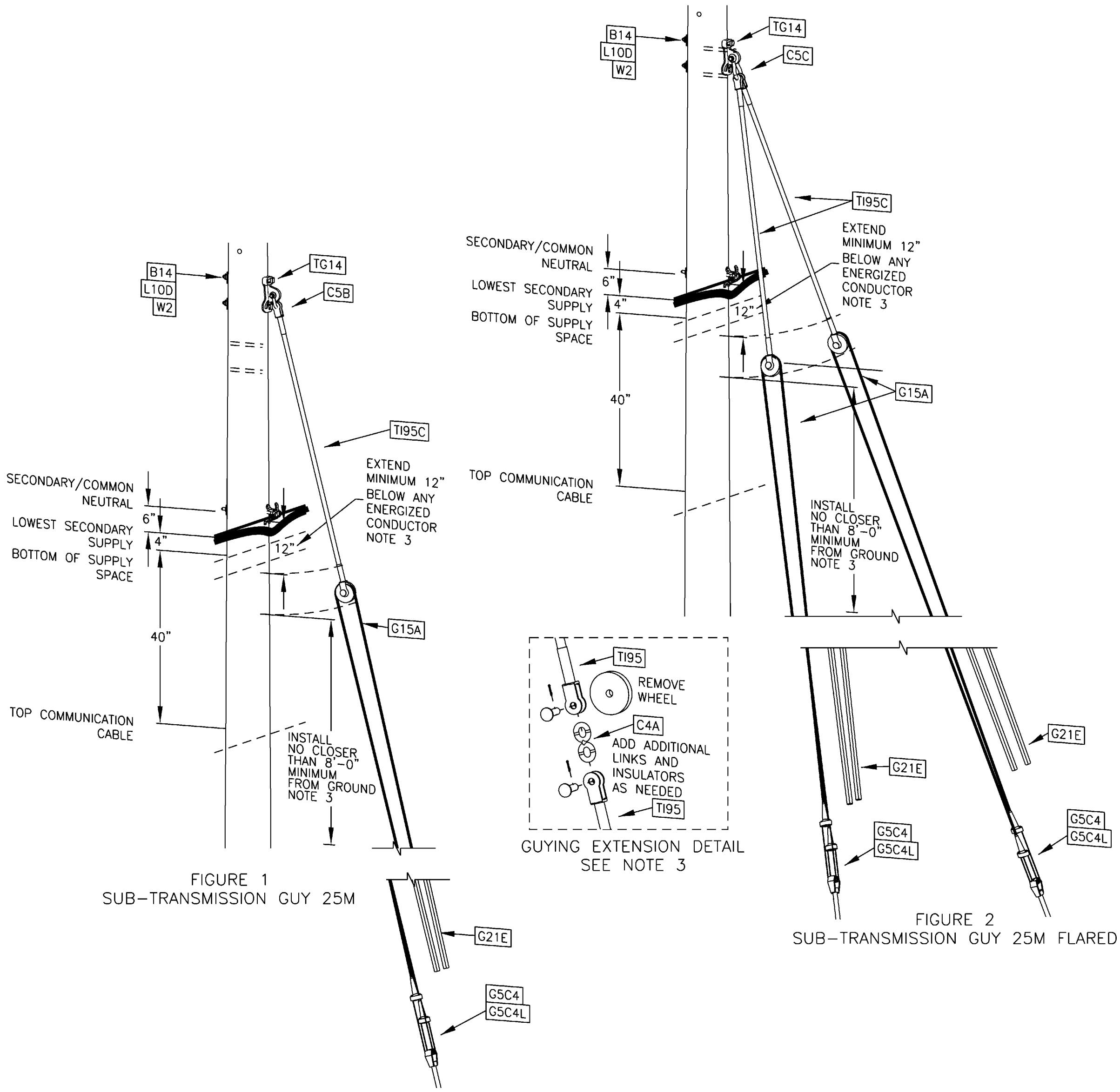


FIGURE 1
SUB-TRANSMISSION GUY 25M

GUYING EXTENSION DETAIL
SEE NOTE 3

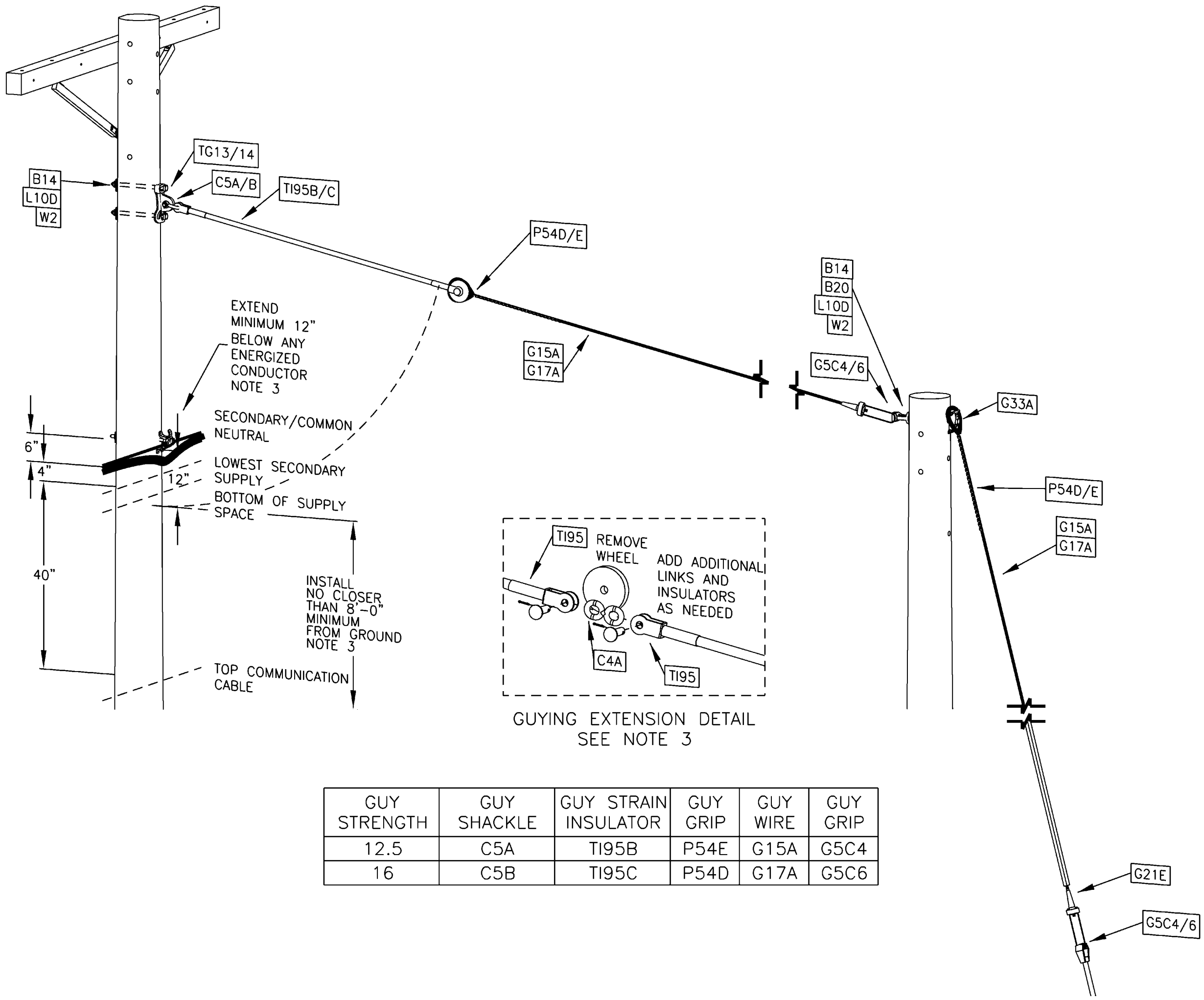
FIGURE 2
SUB-TRANSMISSION GUY 25M FLARED

Designer	Drawing	Date
MPR	od3122	4/30/20

NOTE:

1. THESE GUY ASSEMBLIES ARE INTENDED FOR USE ON SUB-TRANSMISSION LINES.
2. GUY PLATE TG14 REQUIRES TWO, ¾" DIAMETER BOLT (B14) IN BOTH THE UPPER AND LOWER HOLE POSITIONS FOR ALL INSTALLATIONS.
3. FIELD SHALL INSTALL ADDITIONAL GUY STRAIN INSULATORS (TI-95C) OR POSITION THE GUY STRAIN INSULATORS SUCH THAT IF THE GUY WIRE/SPAN GUY BECOMES BROKEN OR SLACK OR IF AN ENERGIZED CONDUCTOR BECOMES SLACK THE FOLLOWING SAFETY CONDITIONS MUST BE MET:
   A) ANY PART OF THE GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED DUE TO CONTACT WITH AN ENERGIZED CONDUCTOR SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   B) THE ENTIRE GUY STRAIN INSULATOR ATTACHED TO A GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   C) THE GUY STRAIN INSULATORS SHALL BE INSTALLED TO LIMIT THE LIKELIHOOD OF AN ANCHOR GUY BECOMING A CONDUCTIVE PATH BETWEEN AN ENERGIZED CONDUCTOR OR PART AND A CONDUCTOR OF ANOTHER CIRCUIT

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission and Sub-transmission with distribution accounting.



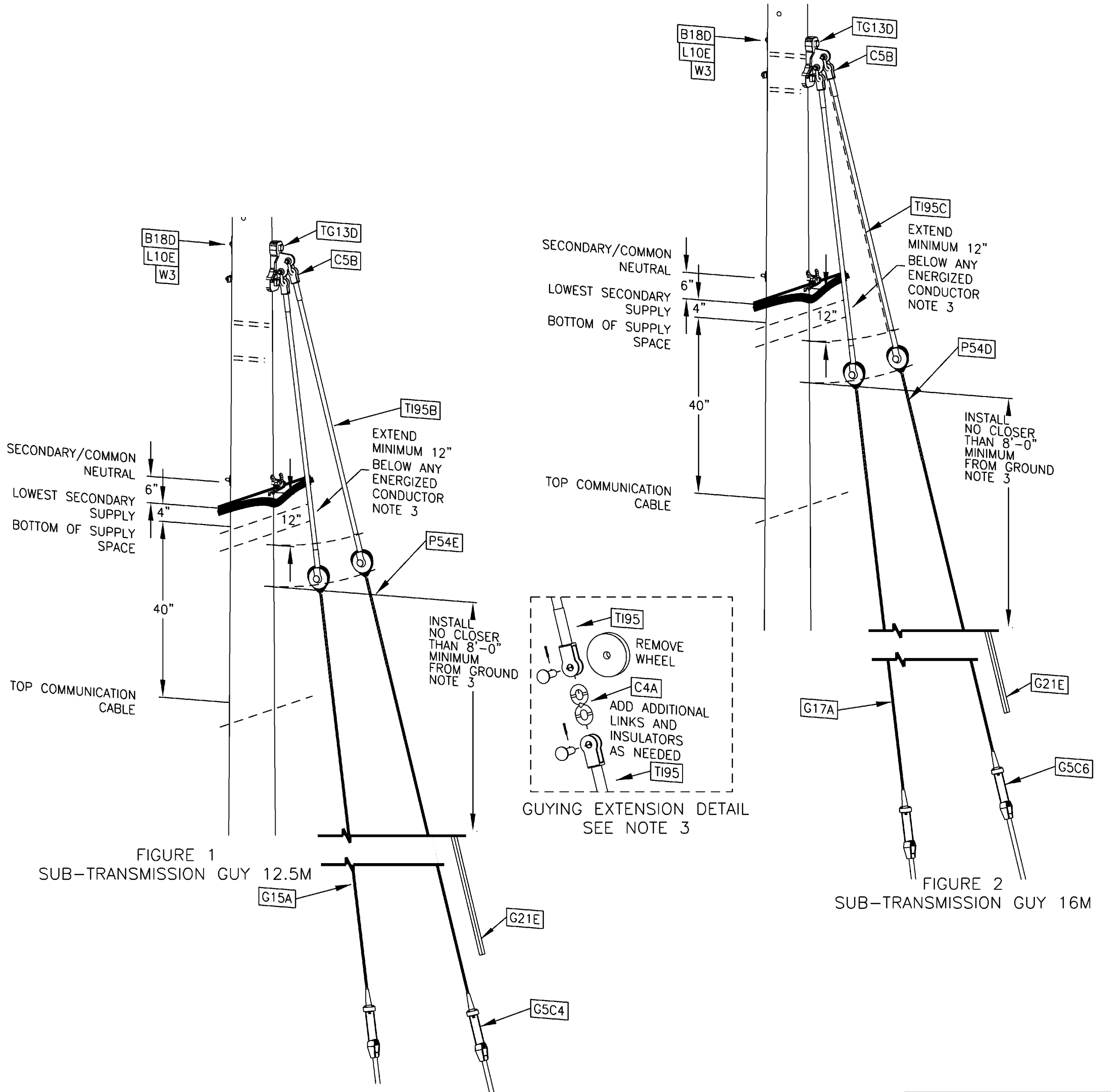
GUY STRENGTH	GUY SHACKLE	GUY STRAIN INSULATOR	GUY GRIP	GUY WIRE	GUY GRIP
12.5	C5A	TI95B	P54E	G15A	G5C4
16	C5B	TI95C	P54D	G17A	G5C6

Designer	Drawing	Date
MPR	od3123	4/30/20

NOTE:

1. THESE GUY ASSEMBLIES ARE INTENDED FOR USE ON SUB-TRANSMISSION LINES.
2. GUY PLATE TG13 AND TG14 REQUIRE TWO, ¾" DIAMETER BOLT (B14) IN BOTH THE UPPER LOWER HOLE POSITIONS FOR ALL INSTALLATIONS.
3. FIELD SHALL INSTALL ADDITIONAL GUY STRAIN INSULATORS (TI-95C) OR POSITION THE GUY STRAIN INSULATORS SUCH THAT IF THE GUY WIRE/SPAN GUY BECOMES BROKEN OR SLACK OR IF AN ENERGIZED CONDUCTOR BECOMES SLACK THE FOLLOWING SAFETY CONDITIONS MUST BE MET:
   A) ANY PART OF THE GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED DUE TO CONTACT WITH AN ENERGIZED CONDUCTOR SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   B) THE ENTIRE GUY STRAIN INSULATOR ATTACHED TO A GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   C) THE GUY STRAIN INSULATORS SHALL BE INSTALLED TO LIMIT THE LIKELIHOOD OF AN ANCHOR GUY BECOMING A CONDUCTIVE PATH BETWEEN AN ENERGIZED CONDUCTOR OR PART AND A CONDUCTOR OF ANOTHER CIRCUIT

NOTE: Refer to NG's MU/CU Construction Manual for appropriate CUs to use for Distribution, Sub-transmission and Sub-transmission with distribution accounting.



Designer	Drawing	Date
MPR	od3124	4/30/20

NOTE:

1. THESE GUY ASSEMBLIES ARE INTENDED FOR USE ON SUB-TRANSMISSION LINES.
2. GUY PLATE TG13D REQUIRES TWO, ⅞" DIAMETER BOLT (B18) IN BOTH THE UPPER LOWER HOLE POSITIONS FOR ALL INSTALLATIONS.
3. FIELD SHALL INSTALL ADDITIONAL GUY STRAIN INSULATORS (TI-95C) OR POSITION THE GUY STRAIN INSULATORS SUCH THAT IF THE GUY WIRE/SPAN GUY BECOMES BROKEN OR SLACK OR IF AN ENERGIZED CONDUCTOR BECOMES SLACK THE FOLLOWING SAFETY CONDITIONS MUST BE MET:
   A) ANY PART OF THE GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED DUE TO CONTACT WITH AN ENERGIZED CONDUCTOR SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   B) THE ENTIRE GUY STRAIN INSULATOR ATTACHED TO A GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   C) THE GUY STRAIN INSULATORS SHALL BE INSTALLED TO LIMIT THE LIKELIHOOD OF AN ANCHOR GUY BECOMING A CONDUCTIVE PATH BETWEEN AN ENERGIZED CONDUCTOR OR PART AND A CONDUCTOR OF ANOTHER CIRCUIT

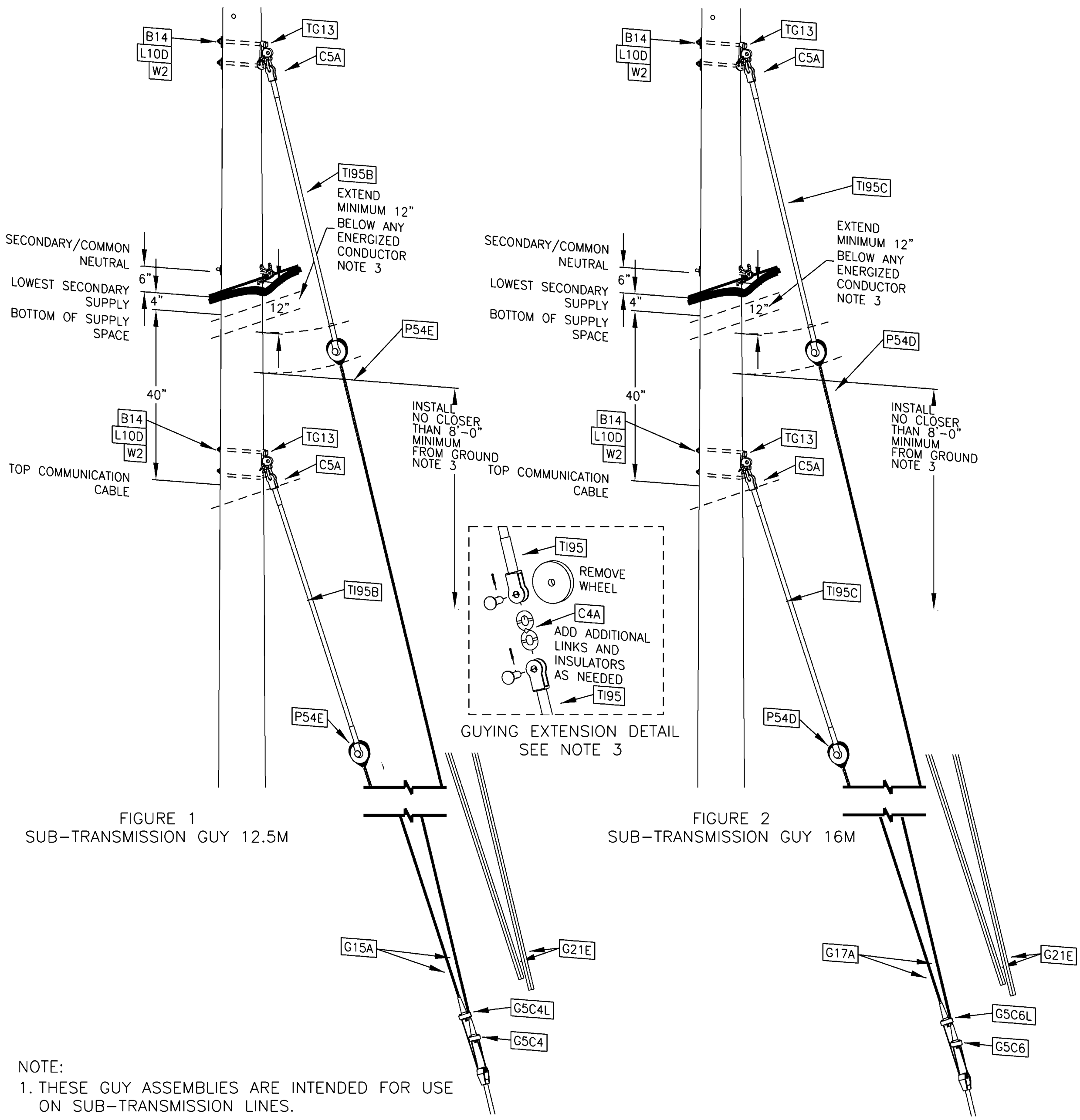


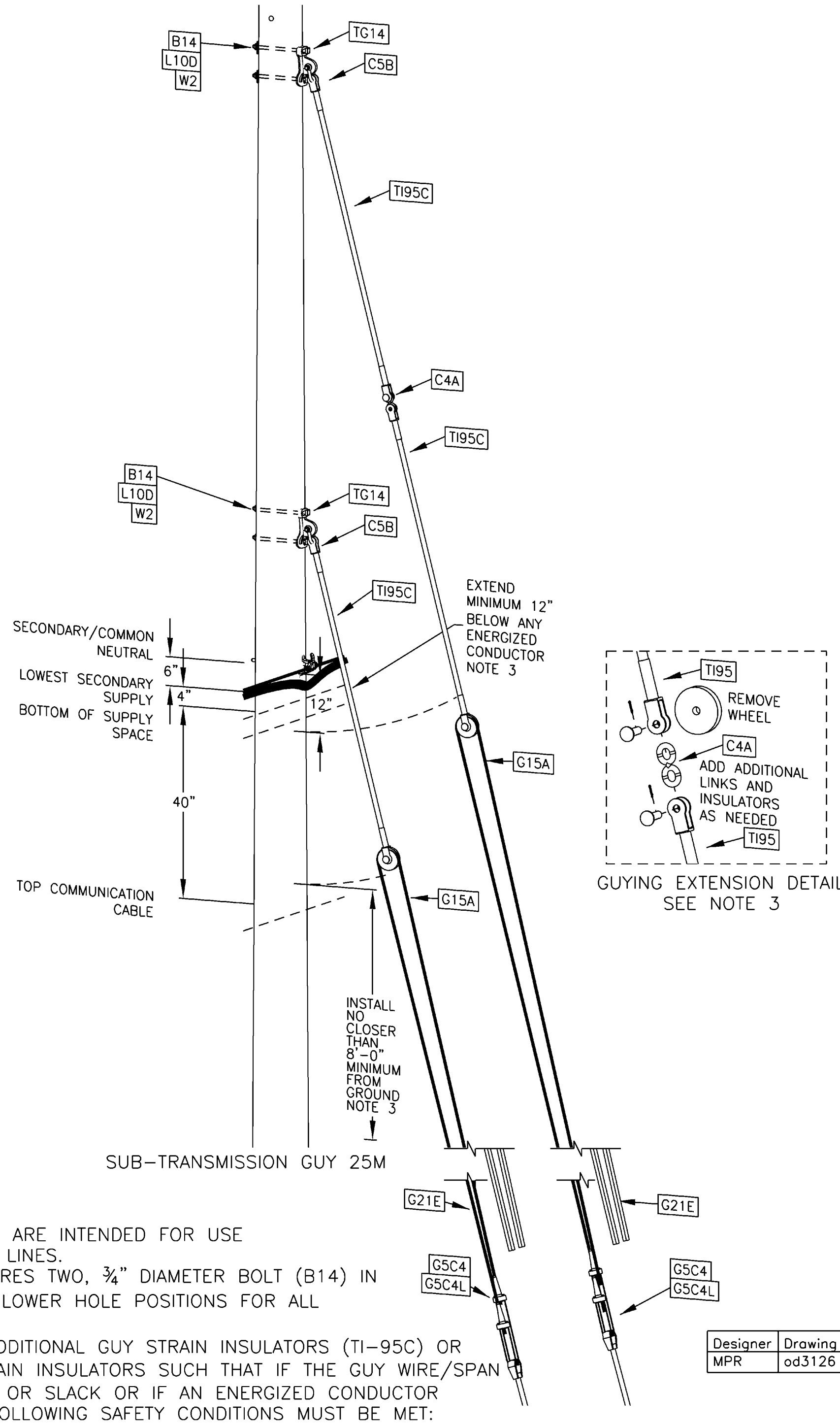
FIGURE 1
SUB-TRANSMISSION GUY 12.5M

FIGURE 2
SUB-TRANSMISSION GUY 16M

NOTE:
1. THESE GUY ASSEMBLIES ARE INTENDED FOR USE ON SUB-TRANSMISSION LINES.
2. GUY PLATE TG13D REQUIRES TWO, ¾" DIAMETER BOLT (B14) IN BOTH THE UPPER AND LOWER HOLE POSITIONS FOR ALL INSTALLATIONS.

Designer	Drawing	Date
MPR	od3125	4/30/20

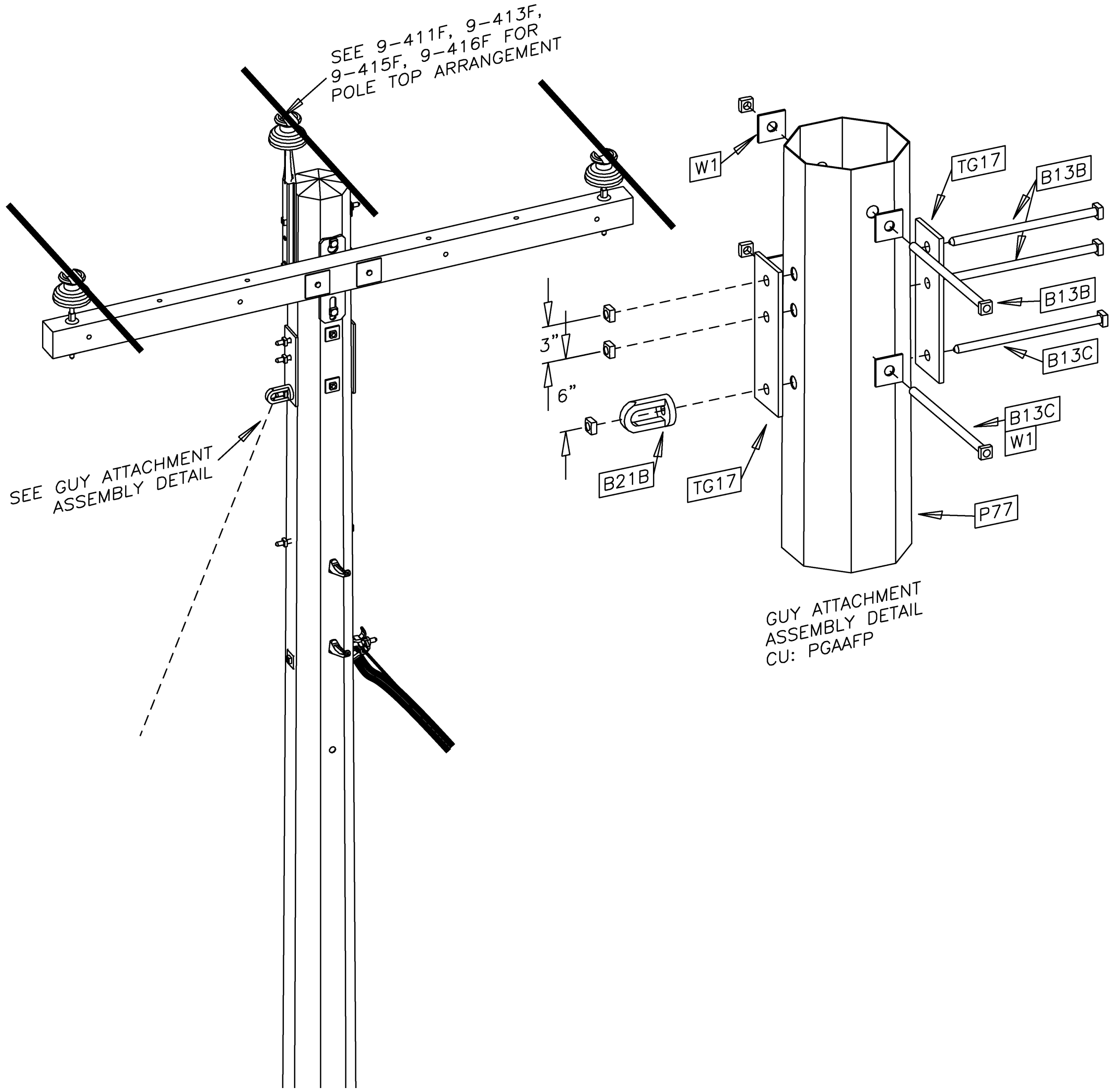
3. FIELD SHALL INSTALL ADDITIONAL GUY STRAIN INSULATORS (TI-95C) OR POSITION THE GUY STRAIN INSULATORS SUCH THAT IF THE GUY WIRE/SPAN GUY BECOMES BROKEN OR SLACK OR IF AN ENERGIZED CONDUCTOR BECOMES SLACK THE FOLLOWING SAFETY CONDITIONS MUST BE MET:
A) ANY PART OF THE GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED DUE TO CONTACT WITH AN ENERGIZED CONDUCTOR SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
B) THE ENTIRE GUY STRAIN INSULATOR ATTACHED TO A GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
C) THE GUY STRAIN INSULATORS SHALL BE INSTALLED TO LIMIT THE LIKELIHOOD OF AN ANCHOR GUY BECOMING A CONDUCTIVE PATH BETWEEN AN ENERGIZED CONDUCTOR OR PART AND A CONDUCTOR OF ANOTHER CIRCUIT



Designer	Drawing	Date
MPR	od3126	4/30/20

NOTE:

1. THESE GUY ASSEMBLIES ARE INTENDED FOR USE ON SUB-TRANSMISSION LINES.
2. GUY PLATE TG14 REQUIRES TWO, ¾" DIAMETER BOLT (B14) IN BOTH THE UPPER AND LOWER HOLE POSITIONS FOR ALL INSTALLATIONS.
3. FIELD SHALL INSTALL ADDITIONAL GUY STRAIN INSULATORS (TI-95C) OR POSITION THE GUY STRAIN INSULATORS SUCH THAT IF THE GUY WIRE/SPAN GUY BECOMES BROKEN OR SLACK OR IF AN ENERGIZED CONDUCTOR BECOMES SLACK THE FOLLOWING SAFETY CONDITIONS MUST BE MET:
   A) ANY PART OF THE GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED DUE TO CONTACT WITH AN ENERGIZED CONDUCTOR SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   B) THE ENTIRE GUY STRAIN INSULATOR ATTACHED TO A GUY WIRE/SPAN GUY THAT MAY BECOME ENERGIZED SHALL NOT BE LESS THAN 8' ABOVE GROUND LEVEL.
   C) THE GUY STRAIN INSULATORS SHALL BE INSTALLED TO LIMIT THE LIKELIHOOD OF AN ANCHOR GUY BECOMING A CONDUCTIVE PATH BETWEEN AN ENERGIZED CONDUCTOR OR PART AND A CONDUCTOR OF ANOTHER CIRCUIT



Designer	Drawing	Date
MPR	od03127	5/15/20

FIBERGLASS POLE GUYING ATTACHMENT

Version	Date	Modification	Author(s)	Approval by (Name/Title)
13	7/21	• Update note 6 on pp 3-115D and 3-115Y • Added dialogue in Section 3.1.30		
12	7/20	• Correct drawings on pp3-121, 3-123, 3-124, 3-125, and 3-126 • Added drawing 3-127		
11	7/19	• Corrected drawing on pp 3-115D, 3-115Y, and 3-125 • Corrected calculation on example 3-35 • Corrected title to 3-126.		
10	7/18	• Corrected footnotes no pp 3-31 and 3-34. • Added Existing Insulated Guy Wire Configuration Guide pp 3-12A and 3-12B.		
9	7/17	• Corrected example #1 Sec 3.7.30 and example #2, Sec 37.40. • Revised drawings 3-105, 106, 107D, 107Y, 108D, 108Y, 109D, 109Y, 111, 115D, 115Y, 118 thru 124. • Added new drawings 3-125 and 3-126..		
8	7/16	• Added Sub-Transmission guy drawing 3-121, 3-122, 3-123 and 3-124.		
7	7/15	• Revised drawing 3-102 to eliminate anchor rod stick-up requirement of 6”-10” and added screw anchor embedment requirement. • Eliminated guy hook TG10. • Added additional bolt information about guy hook TG13 and TG14. • Revised drawings 3-105, 3-108D, 3-109D, 3-109Y, 3-119 and 3-120		
6	7/13	• Added steel stub pole design guide		
5	7/12	• Added provisions for span guys with no primary wires (drawings 3-115D and 3-115Y).		
4	7/11	• Removed open wire secondary information from 3-118 and 3-119 and created new drawing 3-120 with the information. • Revised material used for abrasion protection on span guys (drawings 3-115D and 3-115Y). • Added Section 3.4.60 - Guying on multi-circuit structures.		

3	7/10	• Revisions made to entire section - rearranged information in order to make information easier to locate and understand. • Removed Drawings 3-99, 3-101, 3-113, 3-116, and 3-117. All information from these pages is now in the text portion of the section. • Revised Drawings 3-105 and 3-106 - Updated Primary Guy Wires on Delta Systems. • Revised 3-107 - now split into two drawings to show differences between stub pole guys on delta and wye systems. • Revised 3-108 - now split into two drawings to show differences between sidewalk guys on delta and wye systems. • Revised 3-115 - now split into two drawings to show differences between pole to pole guys on delta and wye systems. • Added Drawing 3-118 to show secondary guy wires on a wye system. • Revised Drawing 3-119 to show only secondary wires on a delta system.		
2	7/09	• Revised wording on pages 3-10 & 3-79 • Updated CUs on drawings 3-102, 3-103, 3-104, 3-105, 3-106, 3-107, 3-108, 3-109, 3-111, 3-112, 3-114, 3-115. • Added Page 3-117, 3-118 & 3-119		
1	7/08	• Section 3.0 modified to clarify bonding and insulation requirements. • Section 3.2.10 – Corrected solid rock soil classification to Class 0. • Corrected section numbering (3.5.10 and 3.5.20). • Step 1, Action – Added reference to Section 10 on page 3-51. • Step 1, Action – Added reference to Section 10 on page 3-54 • Modified note 4 and drawing on page 3-115. • Added column on right hand side of table on page 3-116. • Added pages 3-117, 3-118 & 3-119		

Supersedes 7/16 Issue – Updated page numbers.

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Supersedes 7/16 Issue – Updated Section 4.0 information about EPRI research programs and background information about resiliency.

4.0 GENERAL

Electric utilities have been experiencing more frequent and severe storms over the past several years. At the same time, customer expectations for electric power have changed and interruptions lasting days are no longer acceptable.

Distribution grid resilience may be defined as: "the ability to withstand and reduce the magnitude and/or duration of disruptive events, which includes the capability to anticipate, absorb, adapt to, and/or rapidly recover from such an event." IEEE Technical Report PES-TR65, The Definition and Quantification of Resilience, Page 2, April 2018. In looking at resilience, we look at two time horizons – near-term and long-term. Near-term considerations for resilience focus on operation and restoration after a major event. Long-term considerations focus on infrastructure improvements that must be done before a major event – including aspects of grid operation, vegetation management, and electrical and structural strength and robustness of distribution system components. Resilience considers all hazards and events, including high-impact low-probability events that are commonly excluded from reliability reporting. Often for distribution systems, it is more effective to make the network smarter and more responsive to extreme weather events rather than making the network more redundant. The storm hardening standards discussed in this section focus on one aspect of resilience – making distribution system components more resilient electrically and structurally.

Design, construction and operational changes can approach improved distribution performance during extreme weather events in a number of distinct ways by: (i) reducing the number of customers experiencing outages, (ii) reducing the duration of outages when they are experienced by customers and (iii) mitigating the impact to customers during outages in the distribution system. Distribution resiliency improvements can be achieved through changes in design standards, construction practices, material specifications, and maintenance, inspection and restoration practices. Standards revisions discussed in this section are centered on design standards, construction practices, material specifications. Maintenance, inspection and restoration practices are not addressed in these standards and are being addressed in appropriate operating practices.

PPL is supporting a Grid Resiliency Research Program at the Electric Power Research Institute (EPRI) through funding and participation in the research program's steering committee. This continuing work includes reviewing a number of alternatives: reinforcing overhead distribution structures, adding breakaway devices in overhead conductor supports to reduce overhead structure damage, undergrounding all or portions of the distribution system, and smart grid and distribution automation options to reduce the number of customers affected by distribution system problems. As additional information becomes available from EPRI, its recommendations will be evaluated for inclusion in these standards as appropriate.

4.0.10 Storm Hardening

Our experience is that during extreme weather events, most of the damage to our overhead distribution system is caused by falling limbs and trees. The approaches discussed here attempt to reduce electrical outages caused by trees and limbs or reduce structural damage caused by trees and limbs that cause electrical outages. In particular, the standards discussed here are aimed at limiting the numbers of customers affected by tree and limb related outages and limiting the duration of those outages by allowing partial restoration of feeders and allowing quicker restoration of damaged lines.

4.0.20 Objectives

The standards discussed here are aimed at hardening critical structures and preventing damage to large numbers of structures through cascading failures from a single tree or limb.

Where an individual structure failure would cause outages on multiple feeders or would prevent or slow the restoration of service to customers, such structures are considered critical structures. Tie point structures are considered critical structures because two separate feeders are attached to these structures and failure of a single tie point structure would affect customers on both feeders and the ability to restore service to our customers by transferring loads. Double circuit structures are considered critical structures because two separate feeders are attached to these structures and failure of a double circuit structure would affect customers on both feeders. Recloser structures are considered critical structures because we use reclosers to automatically isolate damaged potions of feeders from undamaged portions and a failure of a recloser structure would mean that customers on both sides of the recloser would remain out of service until the recloser structure could be repaired or replaced. Loadbreak switch structures are considered critical structures because crews use loadbreak switches to isolate damaged potions of feeders from undamaged portions and a failure of a loadbreak switch structure would mean that customers on both sides of the loadbreak switch would remain out of service until the loadbreak switch structure could be repaired or replaced. New and revised standards for hardening critical structures are discussed below.

A single tree or limb can cause the failure of a large number of structures through cascading. Stronger deadend crossarms and the insertion of periodic deadend structures in lines have been adopted as new standards to prevent the failure of large numbers of structures through cascading. The objective of these new standards is to provide faster restoration of service to our customers by preventing the failure of large numbers of structures caused by a single tree or limb.

4.0.30 Implementation Through Standards

While this section of the standards book describes and explains the changes that have been made to our standards for storm hardening, most of the actual changes to our standards are located in other sections of our standards. This is because many of these changes to our standards are intended to be part of our routine construction going forward, not just for use in strom hardening particular feeders.

A. Drawings in Other Sections

This is a list of standard drawings that have been modified to reflect the policies outlined in this section:

1. 9-415 1Φ (Delta) and 3Φ Crossarm Pole Top – 0-15 kV – 46^{o}– 60^{o} Angles / Back-To-Back Deadends (Tangent)
2. 9-416 1Φ (Delta) and 3Φ Double Crossarm Pole Top – 0-15 kV – Angles -61^{o} – 90^{o} and Deadends
3. 9-417 1Φ (Delta) and 3Φ Double Crossarm Pole Top – 0-15 kV Deadends
4. 9-422 1Φ (Delta) and 3Φ (Wye) Crossarm Pole Top – 0-15 kV – To 1Φ (Delta) and 2Φ (Wye) 11^{o} – 20^{o} Tap
5. 9-424 1Φ (Delta) and 3Φ Double Crossarm Pole Top – 0-15 kV Crossings 11^{o}–45^{o} / Angles 21^{o}–45^{o} – Tao To 1Φ (Delta) and 2Φ (Wye)
6. 9-435 1Φ (Delta) and 3Φ Crossarm Pole Top – 0-15 kV – 0^{o} – 10^{o} Tap To 1Φ (Delta) or 3Φ Crossarm
7. 9-835 1Φ (Delta) and 3Φ Armless Pole Top – 0-15 kV – 0^{o} – 20^{o} – Tap To 3Φ Crossarm
8. 12-141 3Φ Primary Sectionalizing - Loadbreak Switch Below Crossarm Installation 15-35 kV
9. 12-142 3Φ Primary Sectionalizing – Conductor Deadend On Loadbreak Switch Installation 15-35 kV
10. 12-143 3Φ Primary Sectionalizing – Loadbreak Switch With Shunt Cutouts Installation 15-35 kV

Supersedes 7/16 Issue –Repaging because of added text.

11. 12-144 3Φ Primary Sectionalizing – Hook Stick Loadbreak Switch Below Crossarm Installation 15kV
12. 12-145 3Φ Primary Sectionalizing – Hook Stick Loadbreak Conductor Deadend On Switch Installation 15kV
13. 12-335 3Φ Electronic Recloser Effectively Grounded Installation 15-35kV
14. 12-338 3Φ Electronic Recloser Effectively Grounded Installation 12.47 kV, 13.2 kV, 13.8 kV Applications with Frame Mounted PTs

B. Design Criteria Adopted in This Section

The following items are design criteria are adopted in this section and are not otherwise found in the standards:

1. Section 4.1.10 D – Multiple Circuit Structures
2. Section 4.1.20 B – Periodic Deadends
3. Section 4.2 – Storm Hardening Existing Lines

C. Design Criteria in Other Sections

A description of NESC Grade B design requirements has been added to the standards in Section 2 – Poles & Hardware.

Supersedes 7/16 Issue – Repaging because of added text.

4.1 APPLICATION TO NEW CONSTRUCTION

Storm hardening standards are now part of our standards for all new construction. In the locations discussed in this section, storm hardened structures will be used for all new or replaced structures. The intent is that the storm hardening provisions discussed in this section become a routine part of all future construction at PPL.

There is no standards requirement to modify existing lines to meet these new standards. However, when a particular feeder or line segment is targeted for storm hardening based on its performance, follow the provisions of Section 4.2 – Storm Hardening Existing Lines, below.

4.1.10 Critical Structures

A. Tie Points

At the ends of feeders, tie points allow the transfer of customer load from one distribution circuit (feeder) to another. The structure at this tie point becomes critical to system performance during extreme weather events because a structure failure will take both circuits out of service (affecting customers on both circuits) and prevent the transfer of load from one circuit to the other where one of the circuits is still in service. These structures can be strengthened by deadending conductors at the structure and strengthening the structure in the directions of the conductors on both sides of the tie point structure.

New Requirements: Our standards now require that all new or replaced structures at tie points be strong enough to remain standing if all of the wires in one direction are broken by falling trees and tree limbs. To meet this requirement, standards now require the following:

1. When a new loadbreak switch or recloser is installed at a tie point structure, including replacements, meet the tie point strength requirements by following current standards for the new loadbreak switch or recloser. These standards can be found at 12-141, 12-142, 12-143, 12-144, 12-145, 12-335 and 12-338.

Note: Standards 12-141, 12-144, 12-335 and 12-338 require class H1 minimum poles for the pole supporting the loadbreak switch or recloser. Standards 12-142, 12-143 and 12-145 require both poles adjacent to the loadbreak switch pole to be class H1 minimum poles.

2. When a new tie point is established without a loadbreak switch or recloser or a tie point structure without a loadbreak switch or recloser is replaced, (i) conductors at the tie point structure shall be deadended in both directions and (ii) the structure shall use a class H1 minimum pole. See standard 9-415 for an appropriate deadend structure.

B. Reclosers / Automatic Switches

Throughout our distribution system, we have a large number of switching points that are used to isolate customers on one part of a feeder from problems on another part of the feeder. Some of these switching points, reclosers, sectionalizers, Scadamate switches and remote controlled loadbreak switches, are parts of automated switching schemes. Failures of these structures affect our ability to quickly restore service to customers on unaffected parts of feeders. As with switching devices at tie points between feeders, these structures can be strengthened by deadending conductors at the structure and strengthening the structure in the directions of the conductors on both sides of the tie point structure.

Supersedes 7/16 Issue –Repaging because of added text.

Our standards now require that all new or replaced structures with reclosers or other automatic switches be strong enough to remain standing if all of the wires in one direction are broken by falling trees and tree limbs. To meet this requirement, standards now require the following:

1. When a new three phase recloser is installed, including replacements, meet the strength requirements for the recloser by following the current standards for the new recloser. These standards can be found at 12-335 and 12-338. EXCEPTION: When replacing a G&W Viper recloser installed before July 1, 2015, if the existing pole is a class 2 minimum, the pole does not need to be replaced with a class H1 minimum pole.

a. Note: Standards 12-335 and 12-338 require class H1 minimum poles for the pole supporting the loadbreak switch or recloser.

C. Manually Operated Loadbreak Switches

Throughout our distribution system, we have a large number of switching points that are used to isolate customers on one part of a feeder from problems on another part of the feeder. Manually operated loadbreak switches are parts of switching schemes used to restore customers during storm events. Failures of these structures affect our ability to quickly restore service to customers on unaffected parts of feeders. As with switching devices at tie points between feeders, these structures can be strengthened by deadending conductors at the structure and strengthening the structure in the directions of the conductors on both sides of the tie point structure.

New Requirements: Our standards now require that structures supporting or surrounding all new or replaced manually operated loadbreak switches be strong enough to remain standing if all of the wires in one direction are broken by falling trees and tree limbs. This requirement does not apply to structures supporting disconnect switches. To meet this requirement, standards now require the following:

1. When a new loadbreak switch is installed with conductors on a separate crossarm above the loadbreak switch (preferred standards 12-141 and 12-144), including replacements, (i) conductors at the loadbreak structure shall be deadended in both directions and (ii) the structure shall use a class H1 minimum pole. EXCEPTION: When replacing a set of underslung disconnect switches with a hookstick operated loadbreak switch (standard 12-144), if the existing pole is a class 3 minimum, the pole does not need to be replaced with a class H1 minimum pole.

2. When a new loadbreak switch is installed with conductors deadended on the loadbreak switch frame (non-preferred standards 12-142 and 12-145), including replacements, strengthen the adjacent structures on both sides of the loadbreak switch structure by: (i) deadending conductors in both directions and (ii) use a class H1 minimum pole. See standard 9-415 for an appropriate deadend structure.

D. Multiple Circuit Structures

Where a single line of poles supports multiple circuits, each of the structures in this line becomes critical to system performance during extreme weather events because a structure failure will take both circuits out service (affecting customers on both circuits). Multiple circuit lines are typically the first part of the feeders near the source substations and extend until the feeders can be separated to go off in different directions to supply customers in different areas. This practice allows all of the circuits coming out of a substation to leave the substation on the public way in front of the substation or on private

Supersedes 7/16 Issue – Added an exception in Section 4.1.10(B)(1).

rights-of way. An outage in this portion of line will interrupt service to all or most of the customers on each feeder.

As discussed above, ongoing EPRI research is investigating the level of strengthening required to prevent lines from falling down when struck by trees and tree limbs.

New Requirements: Until the EPRI results are available, new multiple three-phase circuit lines shall be designed to NESC Grade B requirements. This new design requirement will require stronger conductors, attachments and structures. While implementation of new standard requirement will help reduce mechanical damage caused by trees and limbs, it will not reduce electrical contacts caused by trees and tree limbs and will not eliminate the outages associated with those electrical contacts. Guidance for applying NESC Grade B requirements has been added to Section 2 – Poles and Hardware of our standards. This requirement applies only where there is more than one three-phase circuit line on the structure.

Another option for addressing some of the issues with multiple circuit lines is to eliminate multiple circuit structures by installing the circuits, or all but one of the circuits, underground rather than on a common line of poles. This option would help reduce electrical contacts, as well as mechanical damage, caused by trees and tree limbs and the associated outages. While often not practical, consideration should be given to this option, particularly where additional future circuits along the same route are expected.

4.1.20 Preventing Cascading

A. Periodic Deadends

Portions of overhead distribution lines with a large number of tangent (straight line) pole structures between deadend or other stronger structures may experience cascading failures of poles. When all or most of the wires on one side of a pole are broken, the tension of the wires on the other side of the pole will break poles designed for tangent loads. These failures will cascade down a line of poles until the failures reach a pole with enough strength to withstand the unbalanced loads. Poles with deadends, such as junction poles, and poles with higher strength for other reasons, such as equipment poles and poles with line angles, will often provide adequate strength to stop cascading failures. This strategy will reduce the duration of outages experienced by our customers by limiting cascading failures will limit the number of poles that will have to be replaced at any one location and help reduce the duration of outages experienced by our customers during major storm events.

New Requirements: For new lines in new locations and when major work is performed on a line segment, the design should allow a maximum of 20 spans (19 structures) between structures adequate to stop cascading failures. Deadend structures, junction structures, structures with a line angle over 15 degrees, or storm hardened tie point, recloser or loadbreak structures described above are considered adequate to stop cascading failures. See standard 9-415, 9-715 and 16-115 for examples of appropriate deadend structures. In spacer cable construction, only the messenger must be deadended.

When the EPRI research described above is complete, this alternative will be reevaluated and compared to new alternatives developed in the EPRI research for costs and effectiveness in reducing cascading failures.

B. Deadend Crossarms

Because we are counting on structures with deadends to stop cascading failures, we have reviewed the strength of deadend crossarm alternatives. The fiberglass deadend crossarms that we already use in some special applications are stronger and may give us

Supersedes 7/18 Issue –Modified Grade B requirement for multiple circuit lines.

a longer service life than our standard double wood crossarms for deadend installations. and may give us a longer service.

New Requirements: For most structures with deadend crossarms, we have replaced double wood deadend crossarms with fiberglass deadend crossarms in most of our standard deadend and junction pole structures. These new updated standards can be found at 9-415, 9-416, 9-417, 9-422, 9-424, 9-435 and 9-835 and are intended for use for all new and replacement structures of these types.

While we have incorporated fiberglass crossarms in most of our common structures with deadend crossarms, a number of double wood crossarm applications remain in our standards. These are structures where the double wood crossarms are used in non-deadend applications, such as large running angles, or where the double crossarms are used for mounting special equipment.

Supersedes 7/18 Issue – Repaging because of added text.

4.1.30 Coastline Areas

A. Coastline Areas

For purposes of this section, a "Coastline Area" is any area within 1/2 mile of a saltwater coastline. This definition is different than the "Coastline Area" definition used in Section 8 – Coastline Construction of these standards. As used here, the term "Coastline Area" does not include areas known to experience with heavy road salt contamination that are not within 1/2 mile of a saltwater coastline.

B. Pole Strength Requirements

When new poles are installed in Coastline Areas, install poles that are one pole strength class higher than would otherwise be required by other parts of these standards. Exception: This one pole strength class higher requirement does not apply to poles installed to meet requirements for critical structures in Section 4.1.10 above.

In Coastline Areas, poles will generally be exposed to higher direct wind loads than poles further inland. Distribution poles within 1/2 mile of a saltwater coastline may be directly exposed to severe winds during major storm events. Our historic experience indicates that inland pole failures during these events are the result of damage from trees and flying debris rather than from direct wind loading on poles and wires.

4.2 STORM HARDENING EXISTING LINES

Storm hardening standards are now part of our standards for all new or replaced structures. There is no standards requirement to modify existing lines to meet these new standards. However, when a particular feeder or line segment is targeted for storm hardening based on its performance, follow the provisions should be followed:

4.2.10 Critical Structures

A. Tie Points

Our standards now require that all new or replaced structures at tie points be strong enough to remain standing if all of the wires in one direction are broken by falling trees and tree limbs. When storm hardening an existing line, we recommend the following for tie point structures:

1. Where an existing tie point structure has a loadbreak switch or recloser, the tie point strength requirements may be met by (i) meeting the strength requirements for a new loadbreak switch or recloser at a tie point (see Section 4.1.10(A)(1) above) or (ii) strengthening adjacent structures on both sides of the tie point structure. When strengthening adjacent structures, (i) deadend conductors in both directions and (ii) use a class H1 minimum pole. See standard 9-415 for an appropriate deadend structure.

2. Where an existing tie point structure does not have a loadbreak switch or recloser, (i) conductors at the tie point structure shall be deadended in both directions and (ii) the structure shall use a class H1 minimum pole. See standard 9-415 for an appropriate structure.

B. Reclosers / Automatic Switches

Our standards now require that all new or replaced structures with reclosers or other automatic switches be strong enough to remain standing if all of the wires in one direction are broken by falling trees and tree limbs. When storm hardening an existing line, we recommend the following for structures supporting reclosers or other automatic switches:

1. Where an existing structure has a three phase recloser, the recloser structure strength requirements may be met by (i) following the current standards for reclosers or (ii) strengthening adjacent structures on both sides of the recloser structure. Standards for recloser structures can be found at 12-335 and 12-338. Adjacent structures may be strengthened by (i) deadending conductors in both directions and (ii) using a class H1 minimum pole. See standard 9-415 for an appropriate deadend structure.

C. Manually Operated Loadbreak Switches

Our standards now require that structures supporting or surrounding all new or replaced manually operated loadbreak switches be strong enough to remain standing if all of the wires in one direction are broken by falling trees and tree limbs. This requirement does not apply to structures supporting disconnect switches. When storm hardening an existing line, we recommend the following for manually operated loadbreak switch structures:

1. Where an existing loadbreak switch has conductors on a separate crossarm above the loadbreak switch, the loadbreak switch strength requirements may be met by (i) following the current standards for new loadbreak switches or (ii) strengthening adjacent structures on both sides

Supersedes 7/16 Issue –Repaging because of added text.

of the loadbreak switch structure. The standards for these loadbreak switch structures can be found at 12-141 and 12-145. When strengthening adjacent structures, (i) deadend conductors in both directions and (ii) use a class H1 minimum pole. See standard 9-415 for an appropriate deadend structure.

2. Where an existing loadbreak switch structure has conductors deadended on the fiberglass switch arm, strengthen adjacent structures on both sides of the loadbreak switch structure by: (i) deadending conductors in both directions and (ii) using a class H1 minimum pole. See standard 9-415 for an appropriate deadend structure.

D. Multiple Circuit Structures

Our standards now require new multiple circuit lines to be designed to NESC Grade B requirements. Application of this new design requirement to multiple circuit portions of feeders to be storm hardened is recommended. This new design requirement will require stronger conductors, attachments and structures. While implementation of new standard requirement will help reduce mechanical damage caused by trees and limbs, it will not reduce electrical contacts caused by trees and tree limbs and will not eliminate the outages associated with those electrical contacts. Guidance for applying NESC Grade B requirements has been added to Section 2 – Poles and Hardware of our standards.

Supersedes 7/16 Issue – Repaging because of added text.

4.2.20 Preventing Cascading

A. Periodic Deadends

For new lines in new locations and when major work is performed on a line segment, our standards now recommend that the design should allow a maximum of 20 spans (19 structures) between structures adequate to stop cascading failures. Deadend structures, junction structures, structures with a line angle over 15 degrees, or storm hardened tie point, recloser or loadbreak structures described above are considered adequate to stop cascading failures. Application of this new design requirement to multiple circuit portions of feeders to be storm hardened is recommended

B. Deadend Crossarms

New Requirements: For most structures with deadend crossarms, we have replaced double wood deadend crossarms with fiberglass deadend crossarms in most of our standard deadend and junction pole structures. These new updated standards can be found at 9-415, 9-416, 9-417, 9-422, 9-424, 9-435 and 9-835 and are intended for use for all new and replacement structures of these types. When storm hardening an existing line, we recommend that double wood deadend crossarms be visually inspected and that crossarms showing signs of decay, splitting or other defects be replaced. The new replacement crossarms should be installed to current standards for new or replaced crossarms.

4.2.30 Coastline Areas

A. Coastline Areas

For purposes of this section, a “Coastline Area” is any area within 1/2 mile of a saltwater coastline. This definition is different than the “Coastline Area” definition used in Section 8 – Coastline Construction of these standards. As used here, the term “Coastline Area” does not include areas known to experience with heavy road salt contamination that are not within 1/2 mile of a saltwater coastline.

B. Pole Strength Requirements

Our standards now require that all new or replaced poles in Coastline Areas, be installed with poles that are one pole strength class higher than would otherwise be required by other parts of these standards. Exception: This one pole strength class higher requirement does not apply to poles installed to meet requirements for critical structures in Section 4.2.10 above.

4.2.40 Other Items

A. Lightning Arresters

When storm hardening an existing line, we recommend reviewing the application of lightning arresters on the line for compliance with current standard practices. In particular, where a feeder has a history of poor performance during lightning events, compliance with the reliability based practices in Section 13.6.40 of these standards is recommended.

B. Crossarms

When storm hardening an existing line, we recommend that double wood crossarms be visually inspected and that crossarms showing signs of decay, splitting or other defects be replaced. The new replacement crossarms should be installed to current standards for new or replaced crossarms.

C. Coastal Construction

When storm hardening an existing line in areas covered by our coastal construction standards, we recommend reviewing the existing line against our coastal construction standards (see Section 8 – Coastal Construction) and visually inspecting the line for signs of tracking or corrosion. Such areas are areas within 1/2 mile of a saltwater coastline, areas beyond 1/2 mile from a saltwater coastline where experience shows that the area experiences heavy salt spray and areas where experience shows that the area experiences heavy road salt contamination. Insulators showing visible signs of tracking and electrical connectors showing visible signs of corrosion should be replaced.

Supersedes 7/16 Issue –Repaging because of added text.

4.3 FUTURE UPDATES

This standard and the practices described in it continue to be works in progress. As results become available from the ongoing EPRI work, the practices outlined in this standard will be reviewed to implement best practices based on the available information.

Supersedes 7/16 Issue – Repaging because of added text.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
5	7/19	• Updated 4.1.10(D) to indicate that Grade B construction is only required for lines with multiple three-phase circuit lines		
4	7/18	• Updated Section 4.0 information about EPRI research programs. • Added an exception in Section 4.1.10(B)(1) to the requirement to use a class H1 pole for new reclosers.		
3	7/17	• Added an exception in 4.1.10(C)(1) to the requirement to use a class H1 pole for all hookstick loadbreak switches. • Added additional examples of drawings for deadending conductors to prevent cascading failures and clarified that only the messenger must be deadended in spacer cable construction – Section 4.1.20(A).		
2	7/16	• Corrected References to Section 3 – Poles & Hardware. • Clarified application of requirements for applying new standards in Sections 4.1.10 and 4.2.10. • Added new requirements for Coastal Areas – Sections 4.1.30 and 4.2.30. • Copyright notice headers and repaging revisions throughout the section.		
1	7/15	• Limited H1 pole requirement for reclosers to three phase reclosers at 4.1.10(B) and 4.2.10(B).		

Supersedes 1/08 Issue – Corrected page numbering.

Supersedes 7/16 Issue – Section 5.4; Cold shrink cover is no longer available.

5.0 GENERAL

Automatic, bolted, and compression type connectors are used for all work on the overhead distribution system. All connectors shall be installed using the correct tools, dies, and connectors. Each connector has a specific location to be used (See Page 5-111). Some exceptions may be made for temporary work or for connections that may have to be removed. **Note: All conductors shall be thoroughly cleaned (wire brushed) prior to connector installation.**

5.1 SELECTION OF CONNECTORS

Connector items shall be selected from Pages 5-111 and 5-112. Details of the size range and die index numbers are shown on the material list. Corresponding conductor range and die information, the number of crimps required, and the crimp-limit lines are printed or embossed on the connectors as well. Unless a compression connector, or its packaging, is properly marked for the wire size and die information, a bolted connector shall be employed.

5.2 LOCATION OF CONNECTORS

Splices shall be located where they are needed, but they will not be used on conductors crossing over railroads or limited access highways, or in spans on either side of those crossings.

Automatic tension splices shall not be used on services or slack spans conductors.

When aluminum cables are joined to copper, efforts should be made to keep the aluminum above the copper, and oxide-inhibiting compound/grease (G9B) should be applied between the surfaces.

When installing taps, allow sufficient slack and properly train the tap conductor to avoid putting stress on the connection or conductors.

5.3 CONDUCTOR PREPARATION

Conductor surface preparation is essential to ensure proper contact between conductors and the connector. Surface oxidation and contaminants will greatly interfere with the establishment of a sound electrical connection. An insulating oxide naturally forms on all conductor surfaces exposed to air. The oxide formation is relatively quick and transparent to the eye. **Always** thoroughly wire brush the conductors (both new conductors and conductors in service) before making connections. **Never** use the same wire brush to clean both an aluminum and copper conductor. Copper contaminants transferred to the aluminum conductor will cause the aluminum conductor to corrode. The Standard Item for a wire brush is NTE1 in Section 22-Material Catalog.

5.4 INSULATION OF CONNECTORS

Splices and tap connectors on service/secondary conductors up to 600 V shall be covered with snap-on covers (C60). Bare messenger/neutral connectors shall not be covered.

Splices and tap connectors on bare primary conductors shall not be covered or taped.

Splices on tree wire/spacer cable conductors shall be covered or taped. Tree wire/spacer cable is considered a "covered" rather than "insulated" conductor. **Note**: **Always cover any unused, exposed bare conductor.** Splices on these conductors shall be taped or covered using one of the following methods:

- Gelwrap Cover (C62 & C63) – Use on all 15 kV splices for 1/0 thru 795kcmil. Installation instructions are included in the cover package.
- Cold Shrink Cover (S16) – This Cover is no longer available from the Manufacturer.
- Taped Cover – Use on all 15 kV and 35 kV splices. See Section 16 for installation instructions.

5.5 TYPES OF CONNECTORS

5.5.10 Splices

There are two types of Line splices: Automatic and Compression. Applications should be as specified in A and B below.

All splices must be located a minimum distance of 30 inches from pin insulators for all installations.

For tree wire and covered conductor splicing, remove covering with approved stripper for given conductor size and covering thickness. Always cover any unused, exposed bare conductor per section 5.4.

For Spacer Cable splicing, follow procedures outlined in Section 16. Stagger splices 30” inches from other phases. **Do not** use automatic line splices on spacer conductors.

A. Automatic Line Splices

An automatic line splice is a full tension splice for aluminum and copper conductors (Std. Items S19A thru S19V). They are to be used on full tension conductors only. They are not designed to be used on spacer cable phase conductors, slack spans, or secondary/service cable phase conductor. **Note:** Because service cable is a low tension conductor, an automatic splice shall not be used on a service cable messenger/neutral. See Page 5-141 for installation instructions.

B. Compression Line Splices

A compression splice can be a full tension, partial tension or non-tension splice for aluminum and copper conductors. Full tension splices are used on overhead bare wire and tree wire primary aluminum conductors (Std. Items S20B thru S20G and S20R1 thru S20R4) and copper conductors (Std. Items S23A thru S23N). **Note:** Although spacer cable phase conductors are a partial tension conductor, full tension compression splices shall be used. A partial tension splice is used for secondary/service messengers/neutrals (S22E thru S22H). A non-tension splice is used for non-tension conductors such as secondary/service phase conductors (Std. Items S26C and S26D). See Page 5-144 for installation instructions.

5.5.20 Taps

A. Bolted Connectors

There are several different types of bolted connectors presently used throughout the Company.

1. Parallel Groove Connector

The tap connector is the extruded aluminum parallel groove connector (Std. Items C7A thru C7J). This connector is used for overhead primary aluminum to aluminum or aluminum to copper tap connections. See Page 5-131 for connector sizes and range taking information. **Note:** Cast aluminum parallel groove connectors are not an approved connector and shall not be used for overhead tap connections.

2. Hot Line Clamp/Vice Connectors

Hot line clamp/vice connectors are used in very limited applications. Hot line clamps shall **NOT** be used for temporary jumpers as noted in Standards Bulletin 05-05. The limited applications for hotline clamps/vice connectors are as follows:

- Energized line installations on distribution class primary circuits above 15kV.

Supersedes 7/08 Issue – Added text to Splices – Min dist to insulator and TW /Spacer cable Reqmts.

- Energized line installations or maintenance on primary circuits below 15KV when rubber gloving is not allowed (such as off a pole), or crew make up does not allow gloving above 600 volts (such as OPC/Trouble man).
- Energized line installations of equipment (such as sectionalizers and reclosers) on primary circuits.
- Energized line installations of a line regulator.
- Energized line installation of a lightning arrester. (**Note:** Non-energized arrester connections **MUST** be done with parallel groove or fired on wedge).
- Installation and removal of Current Limiting Fuses used for Capacitor Banks on energized line installations.

There are both clamp and vice type hot line connectors and they are applied as follows:

- Aluminum clamp type hot line connectors (Std. Items C24A thru C24C) are used to tap aluminum primary conductors with an aluminum or copper tap for transformers, capacitors, and primary taps. Bronze clamp type hot line connector (Std. Item C24D) is used to tap copper primary conductors with a copper tap for transformers, capacitors, and primary taps.
- Aluminum vice type hot line connectors (Std. Items C16C thru C16G) are used for mainline connections such as switches, reclosers, and regulators.

Note: Stirrups shall <u>not</u> be used for future installations. See Page 5-147 for installation instructions

3. <u>Split Bolt Connector: Nantucket Use Only</u>

   The split bolt connector is a bronze connector for primary and service/secondary copper conductors only (Std. Items C27A thru C27E). This connector is used in Nantucket on overhead primary and service/secondary that is exclusively copper.

4. <u>Vice Connector</u>

   The vice connector is a single bolt bronze connector for copper conductors only (Std. Items C6N1 thru C6N7). This connector is used for overhead primary copper conductors, streetlighting, and some grounding applications.

B. <u>Compression Connectors</u>

1. <u>Secondary/Services Connections up to 600 Volts</u>

   The H-Tap compression connector is used for secondary/service connections up to 4/0 AWG aluminum to aluminum or aluminum to copper and 600 V maximum (Std. Items S13B thru S13LI). See Page 5-121 for installation information. For secondary/service connections above 600 V, bolted or fired-on wedge connectors shall be used.

2. <u>Primary Connections</u>

   Primary compression tap connectors are not a standard connection and therefore shall not be used.

3. <u>Grounding Connections</u>

   A C-type compression connector shall be used for bonding copper grounding conductors (Std. Items S14A thru S14L). This connector can be installed with a hand or battery operated tool.

Supersedes 7/07 Issue – . Revised HLC usage for equipment and to include cap banks with CLF' s .

C. Fired-on Wedge Connectors

The fired-on wedge connector is used by the Company for overhead primary aluminum to aluminum, or aluminum to copper tap connections (Std. Items S15G thru S15R7). See Page 5-133 for installation information.

5.5.30 Deadends

Deadend connectors are a mechanical connection. They are designed to have a holding strength greater than the maximum tension of the conductor attached to it. They are not designed to be electrical connectors.

A. Bolted Deadends – Strain Clamps (Straight and Quadrant)

Used on distribution primary and larger secondary and service cables for deadening AAC, AAAC, and ASCR conductors. Remove covering on covered conductor before installing the clamps. To select the correct deadend for the conductor desired, See Section 22-Material Catalog Standard Items C13A1 thru C13Q.

B. Formed Deadends

Used for deadending primary and secondary and service cable messengers – AAC, AAAC, AWAC and CW. Also, may be used to deadend primary spacer cable phase conductors. Do not remove covering for latter application. Use with proper thimble clevis or thimble eye. **WARNING:** Do not use with tree wire construction. See Section 22-Material Catalog Standard Items P52A1 thru P52P, and P54A thru P54J.

5.5.40 Terminations

Terminal connectors are used on airbreak/loadbreak switches, transformers, disconnect switches, or any application from aluminum cable to flat aluminum or copper pad or bus bar. **Note:** For applications where taps from copper flat pads to aluminum cables are made, preferred practice is to install copper taps with copper terminal connectors at the copper pads and aluminum tap connectors at the aluminum cables. See Section 22-Material Catalog Std. Item C9.

5.6 COMPRESSION TOOLS AND DIES

Burndy tools and dies, to compress connectors on standard conductors from #6 AWG through 500kcmil, are available. The battery-operated tool can be used for work on services and secondaries up to 4/0 AWG. The hand-operated tool is also available for conductors up to 4/0 AWG.

The HYPRESS Y35 hand-operated hydraulic tool is used primarily for work with larger connectors on conductors through 500kcmil. Although the Y35 will accommodate the same conductor range as the hand-operated tool, it is not generally used on the smaller range conductors (4/0 or less) unless a great number of crimps are required or connectors are used that do not easily yield to compression.

When new tools are to be selected, the Kearny hand-operated tool and the HYPRESS Y35 and dies are suggested. See illustrated tools and a list of standard dies on Page 5-121.

All compression tools shall be tested frequently to see that they are in adjustment. It is desirable that the test be made by the worker who will use the tool. See instructions furnished with the tool.

Supersedes 1/06 Issue – Revised Std. Item reference to C9

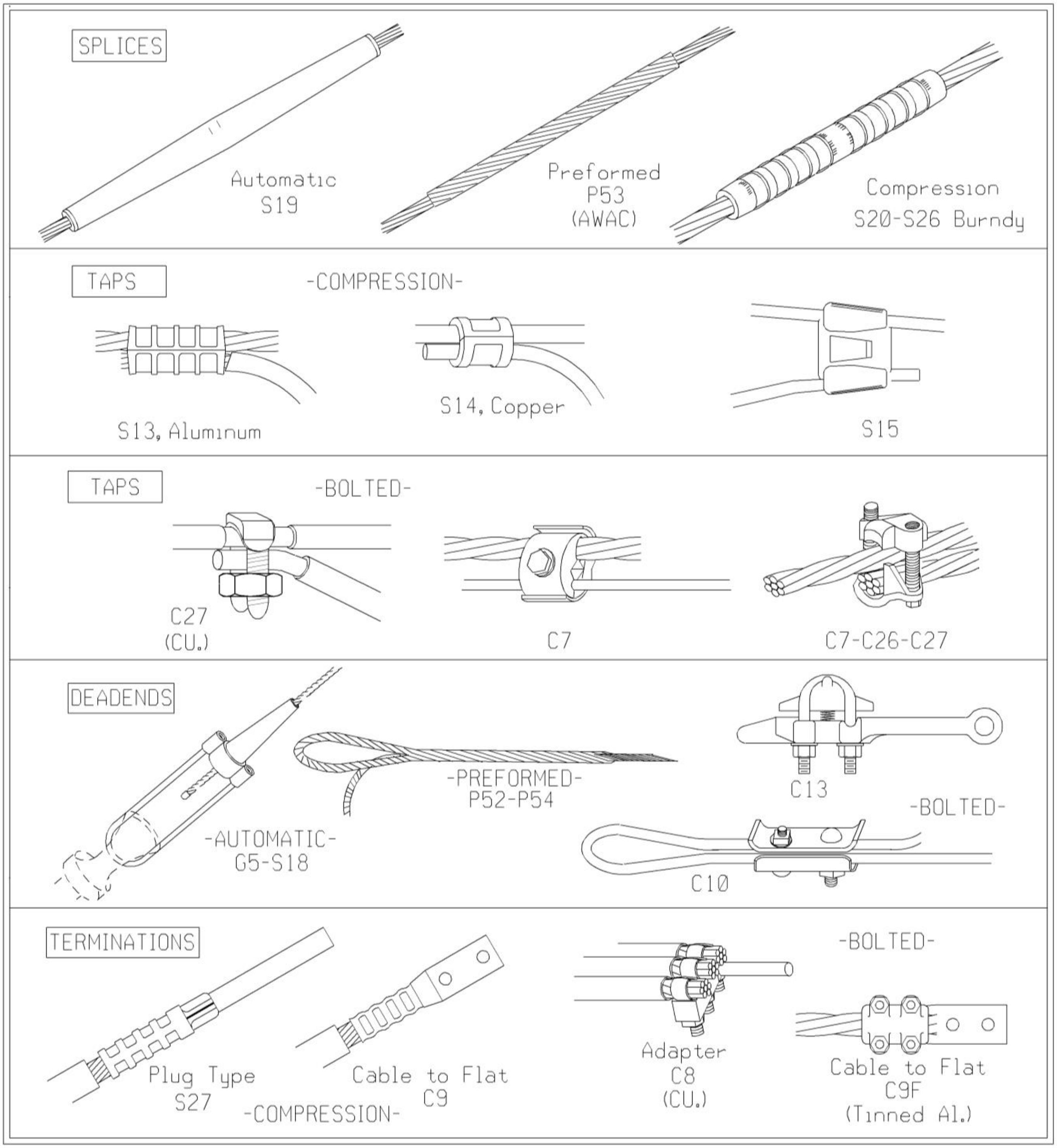
5.7 SELECTION OF CONNECTORS

The following table identifies the different types of connectors used for overhead distribution conductors. The connectors listed below are electrical connectors except for the deadend connectors, which are strictly a mechanical connection

APPLICATION	CONDUCTOR	RECOMMENDATED CONNECTOR (IDENTIFIED BY STD ITEM)				
		AUTOMATIC	PREFORMED	COMPRESSION	WEDGE	BOLTED
SPLICES Full Tension	AL. ACSR AWAC STEEL CU & CCW	S19 S19 S19 S19	 P53	S21 S20 S20 S23		
Partial Tension	AL & ACSR	S19		S22		
Non-Tension	AL. ACSR AL. & CU CU. CCW	DO NOT USE		S13, S26 S13 S13 S14,S24		C7,C26 C7,C26 C27 C27
TAPS	AL. & ACSR AL. & CU CU. & CCW CU. & G.S.			S13 S13 S14 S14	S15 S15	C7,C16, C26 C7,C26, S16 C27,S17 C27
DEADENDS Full Tension	AL. & ACSR AWAC STEEL CU. & CCW	S18 G5	P52 P54 P54			C10,C13 C10,C13
TERMINATIONS Non-tension	AL. CU.			C9,S27 C9,S27		C9 C8,C9
HOT LINE TAPS	AL. & ACSR CU.					C16,C24 C24
GROUNDING & BONDING	CU.			S14		C23,G2, G4

Notes:

1. See Section 22-Material Catalog for Item ID's of each connector using the Standard Items shown above.
2. Full Tension (Class 1) - Splice shall hold at least 95% of the strongest conductor's rated breaking strength.
3. Partial Tension (Class 2) - Splice shall hold a minimum 40% of the strongest conductor's rated breaking strength.
4. Non-Tension (Class 3) - Splice shall hold a minimum 5% of the strongest conductor's rated breaking strength and shall be used for applications such as loops, taps, multiplex cable phase conductors, etc.



Notes:

1. Remove PE or other covering. Avoid nicking conductor.
2. Clean all AL and CU. conductors of oxide scale by wire brushing and oxide inhibitor (G9) on conductor if the connector is not inhibitor loaded.
3. For compression connections, follow package instructions. Check wire size, insert conductor fully and start indents at the center for splices and taps and near the closed end on termination type connectors. On covered service and secondary conductors and primary spacer cable, re-cover connections as shown on Pages 5-151 and 5-152 or use PE covers (C60) where applicable.
4. For installation of automatic splices and deadends, refer to Pages 5141 and 5-142.

5.8 H-TAP CONNECTORS

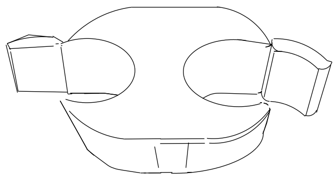


Figure 1

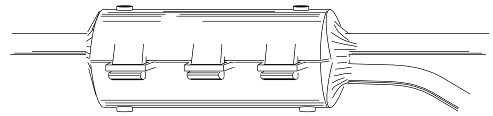


Figure 2

Supercedes Issue 01/06 - Item ID’ s removed, see Section 22.

Table 1

CONNECTOR SERIES ON BOX	H-TAP CONNECTOR (FIGURE 1)	600 V INSULATED COVER (FIGURE 2)
	STD ITEM	STD ITEM
1	S13B	C60E
2	S13H	
4	S13J	C60G
5	S13LI	
6	S13L	
7	S13KI	

Table 2

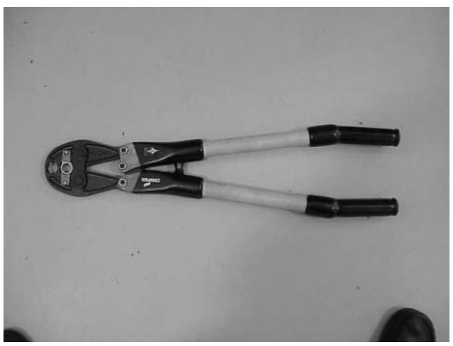
CONNECTOR SERIES ON BOX	RUN RANGE AL. to AL Or AL. to CU		RUN RANGE AL. to AL Or AL. to CU		DIE SIZE	# OF MECHANICAL OR BATTERY OPERATED TOOL CRIMPS	# OF HYDRAULIC TOOL CRIMPS
	Solid	Strand	Solid	Strand			
1	#6 to #1	#6 to #1	#6 to #1	#6 to #1	O	4	2
2	#1 to 2/0	#3 to 2/0	#6 to 1/0	#6 to #1	O	5	2
4	2/0 to 4/0	#1 to 3/0	2/0 to 3/0	#1 to 2/0	D	5	2
5	250 to 300	4/0	#6 to 1/0	#6 to #1	D	5	2
6	250 to 300	3/0 to 4/0	2/0 to 3/0	#1 to 2/0	D	7	3
7	250 to 300	3/0 to 4/0	250 to 300	3/0 to 4/0	D	7	3

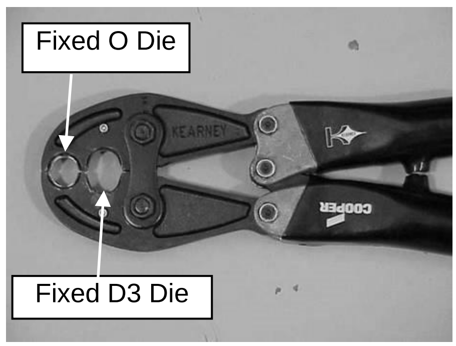
Installation Notes:

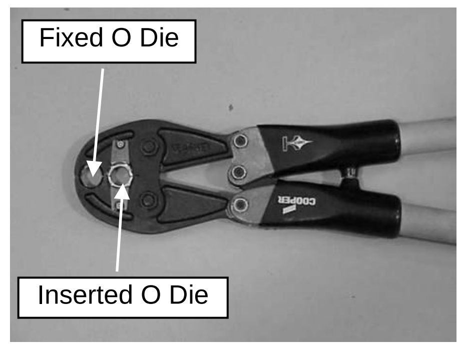
1. For services and secondary connections up to 600 V, H-Tap compression connectors (Figure 1) and insulated covers (Figure 2) shall be used. The H-Tap connectors are for connections of 4/0 aluminum to aluminum or aluminum to copper conductors. Each connector is pre-filled with an oxide inhibitor to maintain a reliable electrical connection. Use insulated covers to insulate the live leg connectors up to 600 V. See Table 1 above for the correct cover to use with a given connector.
2. Each H-Tap connector is shipped in its own box. Each box contains information about the range taking and die size to use. These connectors also have a Connector Series Number that identifies their size. All suppliers use this numbering series. The numbers range from 1 to 7 as indicated on Table 1 and 2. These numbers are also on each connector box to help in selecting the correct connector. Note: The number 3 connector is missing from Table 1 and 2 above because its conductor range is not required in PPL territory.
3. Cables conductors where connections are required, use the Conductor Spreader Tool.
4. All conductors shall be cleaned (wire brushed) prior to connector installation.

5. For aluminum to copper connections, be sure the copper conductor is installed under the aluminum conductor.
6. For a temporary service, bolted connectors may be used if the company's service drop conductors will be remaining at the location (temporary to permanent). If all the conductors are to be removed, use the H-Tap connectors.
7. H-Tap connectors are non-removable. When replacing an existing conductor, remove the insulating cover from the connector, if one is installed, and cut the conductor as close as possible from the connector and recover the connector with a new plastic cover to re-insulate. Then, install a new connector with the new or existing conductor and cover the connector with the plastic insulating cover. Note: There is no need to insulate a neutral connection. Leaving the old H-Tap connectors on the conductor creates no electrical problem with the installation. If available space on the secondary conductor becomes a problem, cut out a section of old secondary conductor and splice in a new piece of conductor.
8. **Warning:** Do not use these connectors for copper to copper conductor connections.
9. H-Tap compression connectors can be installed with a mechanical, hydraulic or battery operated compression tool using an "O" or "D" die as indicated on Table 1. The tools have a build in "D" die. The "O" die is installed into the "D" die of the tool. To simplify the separation of multiplex

MECHANICAL COMPRESSION TOOL







HYDRAULIC COMPRESSION TOOL **BATTERY OPERATED COMPRESSION TOOL**

Supercedes Issue 01/06 – Revised first two paragraphs of 5.9

5.9 INSULATING CONNECTIONS (600 VOLTS)

Connections on insulated Secondary/Service conductors shall be covered with snap on covers. Taping should be avoided unless there are no other options.

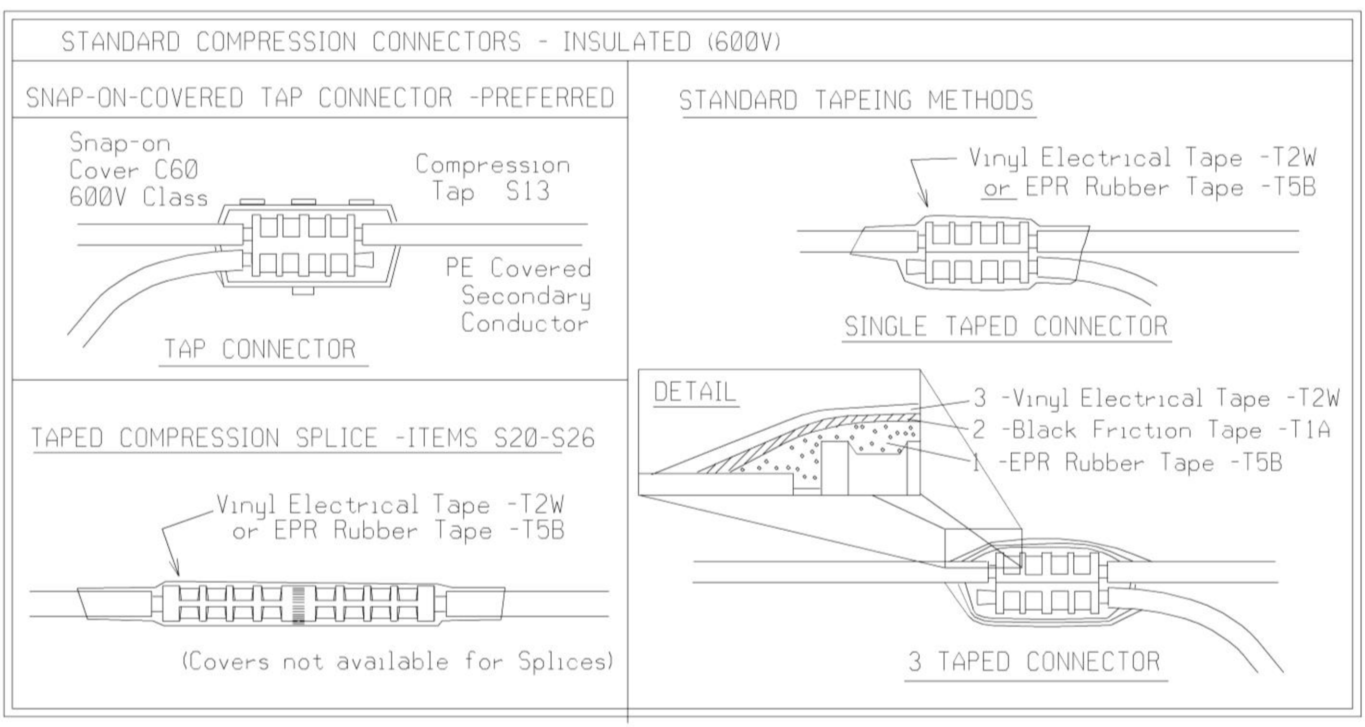
Use snap-on covers (C60) to provide low-voltage protection over compression connectors on covered secondary and service wires. Two or more half-lapped layers of vinyl electrical tape (T2W) or rubber insulating tape (T5B) may be substituted if the proper cover is not available. Do not overstretch the tape and the last two turns should be applied without tension. For nominal 600V insulation class, Polyethylene (or PVC) material provides approximately 200-300V per mil thickness. Unstretched Vinyl tape (T2W) is 8.2 mils thickness and rubber insulating tape (T5B) is 30 mils ("ordinary writing paper is 4 mils thick"). 1 mil = .001 "

Installation Notes:

1. Always clean conductors, wire brushing, (including newly stripped covered conductors) before connector installations. General notes for connector installation can be found on 5-112.

2. Train the conductors so that connections will not be subjected to unnecessary tensions. For large irregular connections or connectors depressions, fill the space with plastic sealer (T5D4).

3. If better insulation or mechanical protection is needed or to buffer sharp edges (i.e. around crimps, etc.) use first a few half-lapped layers of rubber insulating tape (T5B). Apply the rubber insulating tape (as recommended by the manufacturer) so that the sticky side (toward the spool) faces outward as it is applied. This rubber insulating tape is self amalgamating, U.V. and weather resistant but is usually covered using a couple of layers of black friction tape (T1A) and a few outside layers of vinyl tape (T2W). Always use the friction tape between the rubber and vinyl tapes to prevent possible adverse inter-reaction of the materials.



5.10 PARALLEL GROOVE CONNECTORS

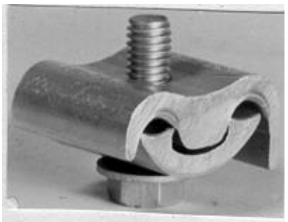


Figure 1

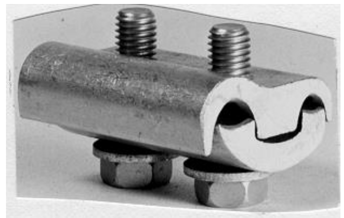


Figure 2

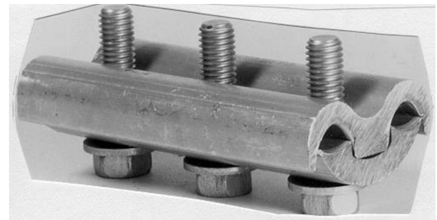


Figure 3

Supersedes 7/13 – Corrected Conductor sizes in table

GROOVE A			GROOVE B					
AAC AL or CU	ACSR, AWAC, AAAC	WIRE DIA. RANGE (INCHES)	AAC AL or CU	ACSR, AWAC, AAAC	WIRE DIA. RANGE (INCHES	STD ITEM	FIGURE NUMBER	BOLT SIZE (INCH)
8 – 2	6 – 2	0.128 – 0.325	8 – 2	6 – 2	0.128 – 0.325	C7A	1	5/16
1/0	1/0	0.338 – 0.398	Str. 12	N/A	0.080 – 0.092	9320571 (SAP ID)	1	3/8
6 – 3/0	6 – 2/0	0.162 – 0.464	6 – 3/0	6 – 2/0	0.162 – 0.464	C7B	1	3/8
2 – 3/0	2 – 3/0	0.292 – 0.502	2 – 3/0	2 – 3/0	0.292 – 0.502	C7E	2	3/8
4/0 – 400.0	3/0 – 336.4	0.464 – 0.743	6 – 2/0	6 – 2/0	0.162 – 0.464	C7D	1	1/2
4/0 – 400.0	3/0 – 336.4	0.464 – 0.743	1/0 – 3/0	2 – 3/0	0.292 – 0.502	C7G	2	1/2
4/0 – 400.0	3/0 – 336.4	0.464 – 0.743	4/0 – 400.0	3/0 – 336.4	0.464 – 0.743	C7I	3	1/2
450.0 – 1000.0 AL & 450.0 – 500.0 CU	477.0 – 795.0	0.743 – 1.152	6 – 3/0	6 – 2/0	0.162 – 0.464	C7DA	1	5/8
450.0 – 1000.0 AL & 450.0 – 500.0 CU	477.0 – 795.0	0.743 – 1.152	4/0 – 400.0	3/0 – 336.4	0.464 – 0.743	C7H	2	5/8
450.0 – 1000.0 AL & 450.0 – 500.0 CU	477.0 – 795.0	0.743 – 1.152	450.0 – 1000.0 AL & 450.0 – 500.0 CU	477.0 – 795.0	0.743 – 1.152	C7J	3	5/8

600 Volt Insulated Covers for these parallel groove connectors only	
Connector – Std Item	Cover – Std Item
C7B	C60R
C7E	C60S
C7D	

Installation Notes:

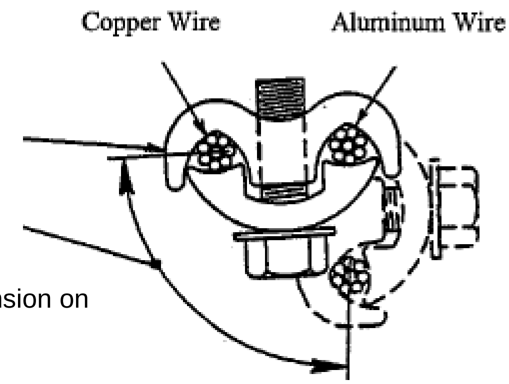


Figure 4

1. Locate larger parallel plate above when possible.
   This provides an "Umbrella Effect" (see Figure 4 on right)

2. Position so rain will not wash from copper wire onto aluminum wire. Use lower position only when necessary.

3. Locate connector in jumper section when possible and not on span wire.

4. The connection is "non-tension" so there should be no pull or tension on the wires in the connector.

5. Clean conductor surfaces with wire brush. Remove all pieces of insulation/covering in case of insulated/covered wire.

6. Connector groove must be clean. Approved connectors are individually packaged in plastic and protected by a covering of inhibitor compound. Wire brushing a new connector is not necessary.

7. In all cases, apply an inhibitor compound (NG9) on the entire aluminum and copper conductor surfaces that will be located within the connector. All voids shall be filled.

8. Free ends shall extend 1/2 inch beyond end of connector.

9. Tighten bolts properly. It is important to use care to tighten bolts uniformly and to recommended torques (see Table 1 below), particularly since aluminum bolts are covered with a grease. **Note: without a torque wrench, bolts should be tightened approximately 3/4 to 1-1/2 turns beyond the point where the bolt is snug in place. WARNING: Do not over-tighten and deform the connector.**

Table 1

REQURIED BOLT TORQUE			
5/16" – 8 lb. ft.	3/8" – 15 lb. ft.	1/2" - 25 lb. ft	5/8" – 40 lb. ft.

10. <u>Do Not Reuse Connectors</u> – Body and bolts may be distorted; also, it is difficult to clean properly and cover all surfaces with compound.

5.11 FIRED-ON WEDGE CONNECTORS

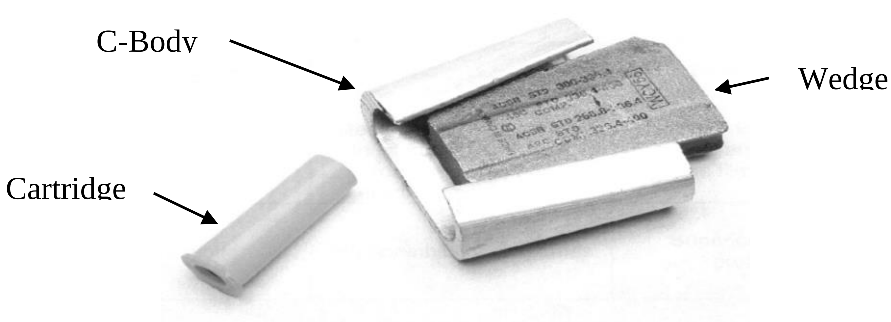
Installation Notes:

1. For complete information about fired-on wedge connector installation/removal and tool use/maintenance, refer to the manufacturer's "Customer Manual".
2. Position so rain will not wash from copper wire onto aluminum wire.
3. Locate connector in jumper section when possible and not on span wire.
4. The connection is "non-tension", and there should be "no-pull" on wires in the connector.
5. Clean conductor surfaces with wire brush. Remove all pieces of insulation/covering in case of insulated/covered wire.
6. Free ends shall extend 1/2 inch beyond end of connector.
7. Select the connector and charge Table 1 below.
8. **WARNING:** Do not reuse connectors as the body and wedge may be distorted; also, it is difficult to clean properly and cover all surfaces with compound.

Supercedes Issue 7/14 – added copper Wedge connectors .

SELECTION CHART			
RUN	**TAP**	**STD ITEM**	**CHARGE COLOR**
1/0 AL. & ACSR	1/0 AL & ACSR	S15G	Blue
1/0 AL. & ACSR	#2 AL	S15H	White
1/0 AL. & ACSR	#4 AL & ACSR	S15J	Red
336.4 AL. & ACSR	336.4 AL. & ACSR	S15L	Blue
336.4 AL. & ACSR	4/0 CU.	S15M	Blue
336.4 AL. & ACSR	2/0 AWAC	S15N	Blue
336.4 AL. & ACSR	1/0 AL. & ACSR	S15N1	Blue
336.4 AL. & ACSR	#2 AL., ACSR, & CU	S15P	Blue
336.4 AL. & ACSR	500 AL. & CU.	S15R5	Yellow
336.4 AL. & ACSR	750 AL. & CU.	S15R7	Yellow
477 AL AAC or 477 (Compact)*	#2 CU	S15S	Yellow
477 (Compact)*	#4/0 CU	S15T	Yellow
477 AL AAC	#4/0 CU	S15U	Yellow
477 (Compact)*	477 (Compact)*	S15V	Yellow
477 AL AAC	477 AL AAC	S15W	Yellow
477 AL AAC	477 (Compact)*	S15X	Yellow
500 CU	#4/0 CU	S17R	Blue
#4/0 CU	#4/0 CU	S17S	Blue
#2/0 CU	#2/0 CU	S17T	Blue

*Spacer Cable



5.12 AUTOMATIC SPLICES

Automatic splices are stamped with the intended conductor range and are color identified at the ends with a band colored pilot-cup.

Approved automatic splices are full-tension, full-current rated devices for application on primary distribution lines.

Installation Notes:

1. Mark the full insertion depth on the conductor by placing the cut-end of the conductor to the connector center-line. See Figure 1 below.

2. Make sure the conductor is cut squarely, cleanly, straight, and free of burrs before insertion. Improper installation is the cause of most premature failures. Separated strands may not enter the internal pilot-cup and become wedged between the gripping jaws, preventing function of these essential components. A temporary tape wrap at the cut location will help reduce strand unwrapping during cutting.

3. **Important Note: All conductors must be cleaned (wire-brushed) immediately prior to making the connection. A non-conductive, thin, and invisible oxide layer begins formation within one minute on aluminum conductors and copper conductors. After wire brushing, immediately add corrosion inhibitor to the cleaned surfaces (Corrosive inhibitor Item ID 8010034)**

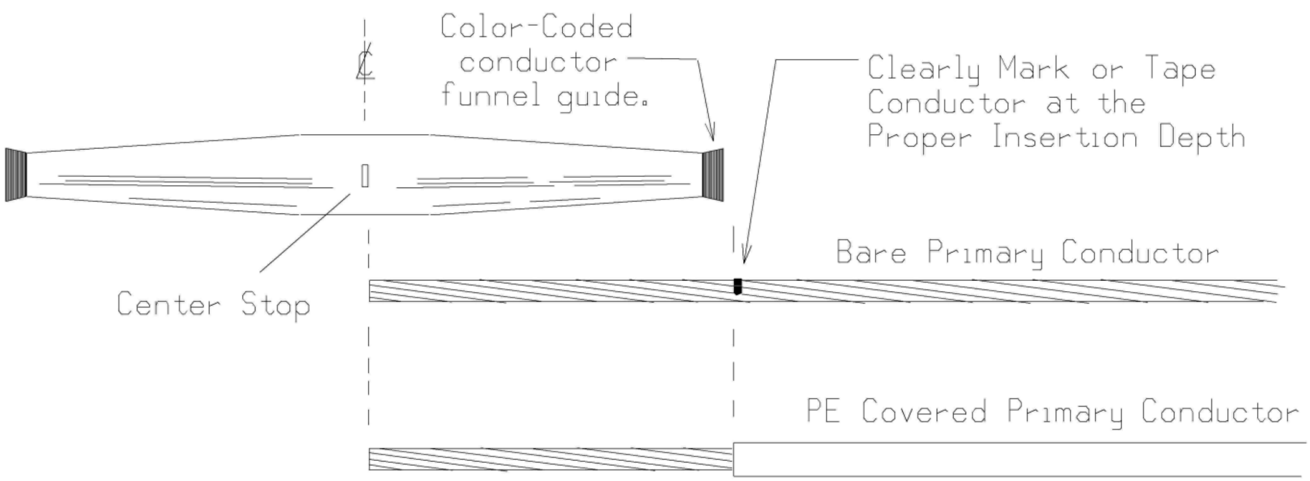
4. Insert the conductor fully into the connector in one complete motion. Do not pull back on the conductor or twist the conductor before insertion is complete. Conductor will move out slightly during final pull-set as the internal jaws "set". Internal pilot-cup must reach full insertion to clear jaws.

5. Automatic full-tension splices are not to be used on spans other that full-tension (i.e. slack spans and services). Wind-caused negative-tension episodes may release the holding jaws.

6. In repairing a burndown, the conductor should be cut back sufficiently to remove stretched, burned, or annealed strands.

7. The following Standard "Automatic" splices and Deadend Connectors can be found in Section 22-Materials Catalog:

- Standard Item G5C – Strand-vice Guy Grips (See Section 3 for application)
- Standard Item S18K & M – Aluminum Conductor Deadends
- Standard Item S19A-I – Copper & Copperweld Conductor Splices
- Standard Item S19J-M – Aluminum Conductor Splices
- Standard Item S19P-R – Steel Strand Splices



Supersedes 1/06 Issue – Added " 3. Important Note" about wire brushing and adding corrosion inhibitor to conductors

Table 1 Automatic Splices for Bare Aluminum Conductors

SPLICE STD ITEM	CONDUCTOR				
	SIZE AWG-KCMIL	CODE NAME	STRANDS	O.D. IN INCHES	CONDUCTOR STD ITEM
S19K	1/0, AAAC	AZUSA	7	0.398	W20A
S19M	336.4 AAC	TULIP	19	0.666	W20B
S19T	477 AAC	COSMOS	19	0.793	W21BA

Table 2 - Automatic Splices for Tree Wire Aluminum Conductors

(**Note:** All other sizes of tree wire/spacer cable shall be spliced with a compression splice. See Section 16 – Aerial/Spacer Cable for splicing details)

SPLICE STD ITEM	CONDUCTOR				
	KV	SIZE AWG-KCMIL	STRANDS	O.D. IN INCHES	CONDUCTOR STD ITEM
S19K	15	1/0 6201	7	0.728	W20CA
S19K	35	1/0 6201	7	1.028	W21NA

Table 3 - Automatic Splices for Non-Standard Bare Aluminum Conductors

SPLICE STD ITEM	CONDUCTOR				
	SIZE AWG-KCMIL	CODE NAME	STRANDS	O.D. IN INCHES	CONDUCTOR STD ITEM
S19J	#4 ACSR				
S19N	2/0 – 3/0				
S19M	394.5 AAC	CANTON	19	0.721	NONE
	636 AAC	ORCHID	37		NONE

Table 4 - Automatic Splices for Non-Standard Covered Aluminum Conductors

SPLICE STD ITEM	CONDUCTOR					
	SIZE AWG-KCMIL	CODE NAME	STRANDS	BARE COND O.D. INCHES	TOTAL O.D. INCHES	CONDUCTOR STD ITEM
S19K	1/0 ACSR	ALMOND	6/1	0.398	0.313	NONE
S19K	1/0 AAAC	OILNUT	7	0.398	0.523	NONE
S19M	336.4 AAC	ANONA	19	0.666	0.791	NONE

Table 5 - Automatic Splice for AWAC Messenger for Spacer Cable

SPLICE STD ITEM	CONDUCTOR			
	SIZE AWG-KCMIL	STRANDS	O.D. IN INCHES	CONDUCTOR STD ITEM
S19L	1/0 – 3/4 AWAC	7	0.487	W21NE

Table 6 - Automatic Reducing Splice for Aluminum Conductor

SPLICE STD ITEM	CONDUCTOR					
	SIZE AWG-KCMIL	STRANDS	CONDUCTOR ITEM ID	SIZE AWG-KCMIL	STRANDS	CONDUCTOR STD ITEM
S19T	477 AAC	19	W21BA	336.4 AAC	19	W20B

Supersedes Issue 7/08 - Some Item ID's

Supersedes Issue 7/08 - Some Item ID's removed, see Section 22.

Table 7 - Automatic Splice for Non-Standard Bare Copper Conductor

SPLICE STD ITEM	CONDUCTOR			
	SIZE AWG-KCMIL	STRANDS	O.D. IN INCHES	CONDUCTOR STD ITEM
S19A	#6 SOL			
S19G	#6A CW & CCW, #4 STR			
S19BB	#3 HD	7	0.260	W11G
S19BB	#3A CW	3	0.326	NONE
S19C	#2 HD	7	0.292	W13B
S19BB	#1 HD	7	0.328	W13I
S19I	#1 HD	3	0.360	W13J
S19I	1/0 HD	7	0.368	W13K
S19B	2/0 HD	7	0.414	NONE
S19D	2/0 CW & CCW	7		
S19E	4/0 HD	7	0.522	W19B

Table 8 - Automatic Splice for Non-Standard Covered Copper Conductor

SPLICE STD ITEM	CONDUCTOR				
	SIZE AWG-KCMIL	STRANDS	BARE COND O.D. INCHES	TOTAL O.D. INCHES	CONDUCTOR STD ITEM
S19BB	#3 HD	7	0.260	0.354	W11H
S19I	1/0 HD	7	0.369	0.494	W13L
S19E	4/0 SD	19	0.528	0.690	W19C

Table 9 - Automatic Splice for Non-Standard Copper Messenger for Spacer Cable

SPLICE STD ITEM	CONDUCTOR			
	SIZE AWG-KCMIL	STRANDS	O.D. IN INCHES	CONDUCTOR STD ITEM
S19U	3/8 CW	7	0.385	NONE

Table 10 - Automatic Reducing Splice for Copper Conductor

SPLICE ITEM ID	CONDUCTOR	
	LARGE END	SMALL END
S28A	4 SOL, 6 STR	6 SOL, 8 STR
S28C1	1 SOL, 2 STR	2 SOL, 3 STR
S28B	2-3SOL, 3 STR	6 SOL, 8 STR
S28C	2-3 SOL, 3 STR	4 SOL, 6 STR
S28D	1/0 SOL, 1 STR	2-3 SOL, 3 STR
S28E	2/0 SOL, 1/0 STR	1/0 SOL, 1 STR
S28F	3/0 SOL, 2/0 STR	2 SOL, 3 STR
S28G	3/0 SOL, 2/0 STR	1/0 SOL, 1 STR
S28H	3/0 SOL, 2/0 STR	2/0 SOL, 1/0 STR
S28J	4/0 STR	3/0 SOL, 2/0 STR

5.13 COMPRESSION SPLICES

Installation Notes:

1. A compression splice installation shall confirm to specific manufacturer's instructions supplied with the splice and as noted below. **Note importance of installation details such as wire brushing and cleaning conductors, measurements and marking, adding oxidizing inhibitor compound when not already included in the connector, conductor straightening, cutting of aluminum strands, installation of steel splice, use of proper die, location of compression, etc.**

2. Compression splices are stamped with the intended conductor range, manufacturer's name, die information, and crimp indicator markings. Crimping inline splice connectors should begin near the center (to allow for connector growth) and successive crimps should be rotated to reduce a "banana" effect.

3. To locate a compression splice, find the type conductor in Table 1 (Aluminum) or Table 2 (Copper) below and look under the associated Standard Item in Section 22-Material Catalog. **Note:** For spacer cable and messenger splice selection and installation information; see Section 16-Aerial/Spacer Cable.

Supersedes 1/06 Issue – Highlighted Importance of installation details, Note 1

Table 1

CONDUCTOR TYPE - ALUMINUM	STD ITEM
Non-Tension One Piece – Service/Secondary Phase Conductors	
#2 and 1/0 AAC Aluminum	S26C & S26D
Partial Tension One-Piece - Service Phase Conductors & Messenger	
#4 AL – 336.4kcmil AL	S22E THRU S22H
Full Tension One-Piece – Primary Conductors	
ACSR Aluminum Conductor	S20B THRU S20G
AAC AND AAAC Aluminum Conductor	S21C1 THRU S21L
Full Tension Two-Piece – Primary Conductors	
ACSR Aluminum Conductor	S20R1 THRU S20R4

Table 2

CONDUCTOR TYPE - COPPER	STD ITEM
Non-Tension One-Piece -	
2/0 & 4/0 CU STR	S24E & S24G
Full Tension One-Piece – Primary Conductors	
CU, CW & CCW	S23A THRU S23N
ACSR Aluminum Conductor	

5.14 HOT LINE CONNECTORS

Hot line clamp/vice type connectors shall be used **only** when Hot Stick work is required. **Note:** Clean conductor surfaces by wire brushing until conductor surface is bright and shiny. **Warning:** Do not damage conductor. New connectors are packaged in plastic and pre-filled with oxidizing inhibitor. **Note:** Do not use stirrups or bails. Do not reuse connectors after use.

Bronze hot line clamp connectors shall be used for copper mainline to copper taps (See Table 1 below).

Aluminum hot line clamp connectors shall be used to connect aluminum mainline to aluminum or copper taps (See Table 2 below).

Aluminum hot line vice connectors shall be used to connect aluminum mainline to aluminum or copper mainline. (See Table 3 below).

Supersedes Issue 7/08 - Item ID' s removed, see Section

Table 1

BRONZE CLAMP TYPE (Figure 1)				
RUN SIZE RANGE		TAP SIZE RANGE		STD ITEM
#6 Solid	400kcmil	4/0	#6 Solid	C24D

Table 2

ALUMINUM CLAMP TYPE (Figure 1)								
RUN SIZE RANGE				TAP SIZE RANGE				
MAX.		MIN.		MAX.		MIN.		
ACSR	AL	ACSR	AL	ACSR	AL & CU	ACSR	AL & CU	STD ITEM
1/0	1/0	#8	#8	1/0	1/0	#8	#8	C24A
336kcmil	394kcmil	#6	#6	3/0	4/0	#6	#6 Sol	C24B
336kcmil	394kcmil	#4	#4	336kcmil	394kcmil	#4	#4	C24C
336kcmil	477kcmil	#6	#6	336kcmil	477kcmil	#6	#6	C24A1

Table 3

ALUMINUM VICE TYPE (Figure 2)				
RUN SIZE RANGE		TAP SIZE RANGE		
MAX.	MIN.	MAX.	MIN.	
AL & ACSR	AL & ACSR	CU & AL & ACSR	CU & AL & ACSR	STD ITEM
336.4kcmil	4/0	336.4kcmil	4/0	C16C
795kcmil	336.4kcmil	1/0	#4	C16D
477kcmil	336.4kcmil	336.4kcmil	#3	C16E
477kcmil	4/0	477kcmil	4/0	C16F
795kcmil	336.4kcmil	795kcmil	336.4kcmil	C16G

Figure 1

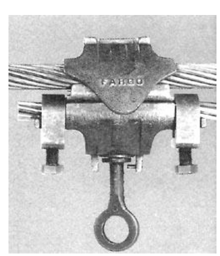


Figure 2

5.15 TERMINAL CONNECTORS

Installation Notes:

1. Install terminal connectors so that water drains from the aluminum to the copper surfaces, i.e., aluminum over copper connection.

2. Clean conductor surfaces thoroughly with wire brush and apply connector inhibiting compound (NG9D) liberally on the conductor and the surface of the terminal.

3. Bolted terminal to conductor using alloy bolts and nuts furnished with connector.

4. Clean pad on equipment with wire brush and apply connector compound (NG9D) on entire contact surface. Bolt surfaces together, using stainless steel bolts (B8B15 thru B8C30), nuts (B8C40) flat washers (B8W3) and Belleville washers (B8W10). See Figure 1.below.

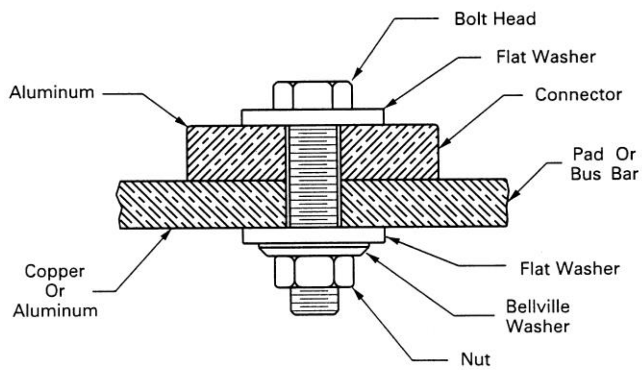


Figure 1

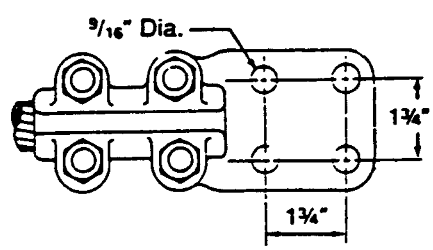


Figure 2

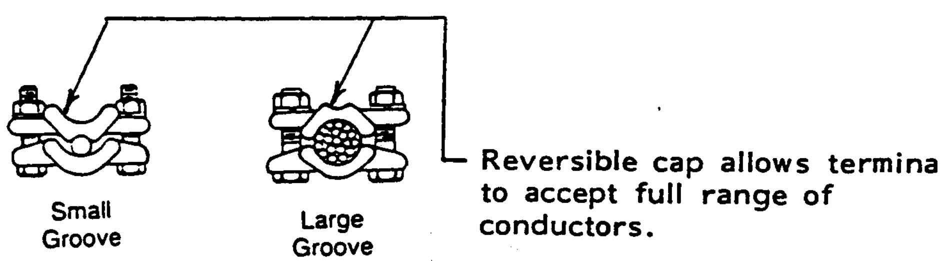


Figure 3

5.16 REPAIR SLEEVES

Table 1 below shows material to repair damaged bare overhead aluminum conductors. The materials include line guard, armor rod and compression sleeves. The repair material to choose depends upon the number of broken conductor strands as shown in Table 1. Table 2 shows tools and dies for installing compression sleeves.

Some Item ID's removed, see Section 22.

Table 1

Wire Size		Line Guard		Armor Rod		Compression Sleeve	
All Aluminum AAC, All Aluminum Alloy (AAAC) and Spacer Cable (Compact)	**Cond. Dia. in.**	**Max. Broken Strands**	**Std Item / SAP ID**	**Max. Broken Strands**	**Std Item / SAP ID**	**Max. Broken Strands**	**Std Item / SAP ID**
1/0 AAAC 7 str. concentric	0.396	1	P51C	2	9319672		
4/0 AAC 7 str. concentric	0.522	1	9313104			3	9313353
4/0 AAAC 7 str. concentric	0.563	1	9313104			3	
336.4 AAC 19 str. - concentric	0.666	3	9315738	5	9319674	9	9312431
477 AAC 19 str. - concentric	0.793	3	9313126				
636 AAC 37 str. - concentric	0.918	4	9313187				
795 AAC 37 str. - concentric	1.026	4	9313184				
ACSR Conductors							
1/0 ACSR 6/1	0.398	1	P51C			3	9315764
3/0 ACSR 6/1	0.502	1	9314042				
336.4 ACSR 18/1	0.684	4	P51G				
477 ACSR 18/1 Pelican	0.814					9	9313355

Table 2

		Compression Sleeve Tools and Dies					
Wire Size	**Cond. Dia. in.**	**Std Item / SAP ID**	**Splice Cat.#**	**Tool 6 Ton MD6 BCT500 PATMD6**	**Tool 12 Ton Y35 Y750 PAT5018V**	**Tool 15 Ton Y46 PAT4618V**	**Tool 60 Ton Y60BHU**
4/0 AAC 7 strand	0.522	9313353	YCU28A	W249 (28)	U249 (14)		
4/0 AAAC 7 strand	0.563						
336.4 AAC 19 strand	0.666	9312431	YCU301A		U321 (20)		
1/0 ACSR 6/1	0.398	9315764	YCU25R	W243 (20)	U243 (10)		
477 ACSR 18/1	0.814	9313355	YOU321R		U327 (21)	U327 (21) with PT-6515 adapter	L327 (7)

Version	Date	Modification	Author(s)	Approval by (Name/Title)
7.0	7/20	• Corrected index numbering error.		
6.0	7/17	• Added note to 5-1 regarding coldshrink discontinuation • Removed taping reference on 5-1		
5.0	7/16	• Added slacking of taps in Section 5.2 • Added use snap on covers on services and secondary to 5.9. • Added Copper fired on wedges to 5.11		
4.0	7/15	• Corrected table in section 5.10 Pg. 5-131		
3.0	7/14	• Added fired on wedge connectors for 477 conductor.		
2.0	7/13	• Removed PS Item ID's through out entire section. Added SAP ID's		
1.1	7/12	• Added use of hot line clamps for CLF's on capacitors in section 5.5.20 • Added Min dist to insulator and TW/Spacer requirements in Section 5.5.10. Added note to 5.4		
1	07/08	• Revised hot line clamp usage rewording, added note of lightning arresters in 5.5.20. • Revised Std. Item reference to C9 in 5.5.40. • Corrected connector cover Item ID in 5-10. • Changed charge color for Item ID 3507246 from red to white in 5.11. • Added Note 3 in 5.12. • Changed Item ID 0806400 to 0806404 and added reducing splice Item ID 9201781 on page 5-143. • Highlighted Importance of installation details in Note 1 in section 5.13. • Deleted reference to 25kV and 35kV and added Item IDs to Tables 1, 2, and 3 in section 5.14.		

Supersedes 7/17 Issue – Corrected description of " Planetree" to AAAC.

6.0 GENERAL

This Section covers the physical and electrical data on standard primary conductors and those that have been commonly used on overhead distribution systems.

Detailed design data for primaries, aerial and spacer cable, street lighting, and other specific conductor applications are covered in their respective sections of the text.

6.1 BASIC DATA

Basic conductor data is shown on drawings and tables indicated in the index. This data may differ in minor detail from those shown in other handbooks. The information shown here, however, should be used for all Company records and correspondence unless otherwise approved. If there are any questions concerning accuracy, please consult Standards Engineering.

6.1.10 Definitions & Notes:

PE = Regular Polyethylene Covering
AAC = All Aluminum Conductor (Type ECA or EC)
AAAC = All Aluminum Alloy Conductor, 5005 or 6201 aluminum alloy
1/0 AAAC (123.3 kcmil) is the electrical equivalent of 1/0 ECA
4/0 AAAC (246.9 kcmil) is the electrical equivalent of 4/0 ECA
394.5 kcmil AAAC is the electrical equivalent of 336.4 kcmil ECA
XLPE = Cross-Link Polyethylene Covering
HDPE = High Density Polyethylene Covering
ACSR = Aluminum Cable Steel Reinforced
CCW = Copper – Copperweld
ECA = Electrical Conductivity Aluminum, also known as “All Aluminum” or “AAC”
HD = Hard Drawn Copper
SD = Soft Drawn Copper

Note 1 – The outer layer on aluminum cable shall be right-hand twist (on copper, left-hand twist).
Note 2 – A Mylar separator shall not be included between the conductor and the insulation.
Note 3 – Manufacturer’s identification shall be printed on the outside of the covered conductor covering.
*Note 4 – Although tree wire /spacer cable and other covered line conductors offer some electrical protection, it is **NOT INSULATED CONDUCTOR** and shall not be depended upon in this respect.*

Loading Definitions

Deadend - Maximum tensions that will exist under conditions of “Heavy Loading” in conductors strung to standard sags. Values for NESC Grades B & C are based on 60% rated breaking strength; however, a 50% rated breaking strength value shall be employed for all new work. Values for Grade N are based on 70% rated breaking strength. These are furnished for use when maintaining existing Grade N lines. Use these values for guy and pole strength calculations and for calculation of crossarm strength at deadends.

Transverse - Loads resulting from a 4 lb./sq.foot wind blowing at right angles to the line with conductors covered by ½ inch ice (Heavy Loading). Use these values for transverse guy and pole strength calculations.

Vertical - Weight of conductors plus ½ inch radial ice. Use these values for calculations of vertical crossarm strength.

Total - Total resultant of vertical and transverse loads on conductors under "Heavy Loading" plus an adder of 0.30 lbs./foot (Total Load = $\sqrt{(T^2 + V^2)}$ + 0.3 lbs./foot). Use for slack span calculations and for other sag and tension problems.

Swing Angle - Angle at which the conductor will be displaced from the vertical by a 6 lbs./sq. foot wind blowing at right angles to the line at 60˚F/15˚C. Use these values for horizontal clearance calculations. Calculate horizontal displacement by R sine α where R = max. sag and α = swing angle.

Swing Angle = $\alpha = \tan^{-1}\left(\frac{W_h}{W_v}\right)$

$W_h = \frac{P}{12} \times d$ P = 6 (6 lbs./sq. foot), 12 Inch Conductor Length

d = Conductor Diameter

W_v = Unloaded Weight of Conductor (lbs./foot)

6.2 SAGS AND TENSIONS

All overhead lines must meet minimum clearance requirements of the NESC in force at the time the line is constructed. Prior to the 1977 issue of the NESC, minimum basic clearances allowed for increased sag due to ice loading or operation at a 120˚F/50˚C maximum conductor temperature.

The 1977 revision to the NESC, under Rule 232B2, permits the owner to establish a conductor maximum operating temperature while maintaining minimum clearance requirements. The Company has established a 176˚F/80˚C maximum allowable conductor operating temperature under normal conditions and a 194˚F/90˚C maximum allowable conductor operating temperature under emergency conditions for a specific period of time.

6.2.10 Limiting Tensions

In the design of overhead lines, three limiting values of tension shall be observed:

A. Initial Unloaded or Stringing Tension is that which will exist before the application of any external load or immediately after new conductors have been installed. The initial unloaded tension at 0˚F/-18˚C shall not exceed 35% of rated breaking strength. The temperature of 0˚F/-18˚C is used instead of 60˚F/15˚C required by the NESC because the aluminum manufacturers have indicated that 0˚F/-18˚C is more critical for aluminum than 60˚F/15˚C. Although it is not necessary, the 0˚F/-18˚C tension is used for conductors other than aluminum to be consistent.

B. Maximum Design Tension is that to which the conductor is subjected upon occurrence of the maximum climatic loading specified for design work in the NESC Heavy Loading area. The maximum conductor tension, either initial or final, shall not exceed 50% of rated breaking strength. This limit is less than the 60% required by the NESC to allow for higher tensions due to spans longer than the ruling span and to allow for slight tolerances in sagging. A 2,000 lb. tension limitation is common for most distribution conductors, especially those that deadend on crossarms. All conductors except spacer cable messengers and specially noted conductors shall be limited to an approximate maximum tension of 2000 lbs. A 3,000 lb. tension limitation is acceptable, with appropriate hardware, in situations where the resulting line has a clear advantage over standard 2,000 lb. design because of lower costs due to longer spans or improved appearance of the line.

C. Final Unloaded Tension is that which the conductor assumes under no external loading but after the maximum design tension has been sustained for sufficient time to permit stretching to cease. The final unloaded tension at 0˚F/-18˚C shall not exceed 25% of rated breaking strength. The 0˚F/-18˚C tension is used for the same reason as in the above criteria A.

The sag tables demonstrate sags under various temperatures and loading conditions. New conductors strung to "Stringing" (Initial) values will have initial, maximum and final tensions as specified. The sag will increase under design loading, then change as shown in "Final" sags depending on temperature and loading.

The Initial Sag tables are based on the Ruling Span Method of calculation and the Final Sag tables are based on the Deadend Method, as discussed below. In the event that Initial or Final Sags that are not shown are required, contact Standards Engineering.

6.2.20 Deadend or Uniform Spans

Sag tables based on deadend span methods assume that there is only one span or that all spans are the same length. This method is useful for short spans in urban areas where the spacing is reasonably uniform. If long spans in a section of line are sagged according to a deadend table, short spans in the same section will have a sag value that may or may not correspond with the table. For this reason, it is customary to sag a span of average length near the center of the line and to recognize that there may be slightly more or less sag in the longer and shorter spans than is indicated by the tables.

In order to determine the sag value for a specific span length, multiply the ruling span sag value by the ratio provided in Table 1 for the corresponding actual span length. In the event that the needed actual span length is not provided in this table, a method for determining the resultant ratio value is provided below.

Table 1
Ratio of Deadend Span Sag to Sags at Other Span Lengths with Same Tension

ACTUAL SPAN	DEADEND SPAN										
	50'	75'	100'	125'	150'	175'	200'	225'	250'	275'	300'
100'	4.00	1.78	1.00	0.64	0.44	0.33	0.25	0.20	0.16	0.13	0.11
110'	4.84	2.15	1.21	0.77	0.54	0.40	0.30	0.24	0.19	0.16	0.13
120'	5.76	2.56	1.44	0.92	0.64	0.47	0.36	0.28	0.23	0.19	0.16
130'	6.76	3.00	1.69	1.08	0.75	0.55	0.42	0.33	0.27	0.22	0.19
140'	7.84	3.48	1.96	1.25	0.87	0.64	0.49	0.39	0.31	0.26	0.22
150'	9.00	4.00	2.25	1.44	1.00	0.73	0.56	0.44	0.36	0.30	0.25
160'	10.24	4.55	2.56	1.64	1.14	0.84	0.64	0.51	0.41	0.34	0.28
170'	11.56	5.13	2.89	1.85	1.28	0.94	0.72	0.57	0.46	0.38	0.32
180'	12.96	5.76	3.24	2.07	1.44	1.06	0.81	0.64	0.52	0.43	0.36
190'	14.44	6.42	3.61	2.31	1.60	1.18	0.90	0.71	0.58	0.48	0.40
200'	16.00	7.11	4.00	2.56	1.78	1.31	1.00	0.79	0.64	0.53	0.44
210'	17.64	7.84	4.41	2.82	1.96	1.44	1.10	0.87	0.71	0.58	0.49
220'	19.36	8.60	4.84	3.10	2.15	1.58	1.21	0.96	0.77	0.64	0.54
230'	21.16	9.40	5.29	3.39	2.35	1.73	1.32	1.04	0.85	0.70	0.59
240'	23.04	10.24	5.76	3.69	2.56	1.88	1.44	1.14	0.92	0.76	0.64
250'	25.00	11.11	6.25	4.00	2.78	2.04	1.56	1.23	1.00	0.83	0.69

Method for Determining Ratio:

1. Choose Deadend Span.
2. Find deadend span sag from sag table for temperature and deadend span desired.
3. Multiply deadend span sag by above ratio for actual spans as line is laid out to obtain actual span.
4. For deadend span to actual span ratio other than those listed above:

$$RATIO = \frac{(ACTUAL\ SPAN)^2}{(DEADEND\ SPAN)^2}$$

6.2.30 **Ruling Spans**

This is a calculated span length for which the conductor tension, under changes in temperature and loading, best represents the average tension in the conductor in a particular series of spans between deadends. Ideally, a line should be installed in such a way that all spans of the line have equal horizontal line tension. If this is done, longitudinal forces on pole tops between spans are theoretically zero. Deadend poles and poles located at bends in the line will typically require guying in order to counteract the line tension.

Sag tables based on the ruling span method recognize variations in span length. This method assumes that the line will be strung to uniform tension. If this is done, all spans will have initial sags that are very near the values in the table. After the conductors are tied into place, however, and after ice and wind loads stretch the wires, the tension may not be uniform and the sags may vary from the calculated values. If the actual spans are much longer or shorter than the ruling span, the tension and sags may be different than the calculations.

The ruling span can most accurately be determined through the following equation:

$$\text{Ruling Span} = \sqrt{\frac{(L_1{}^3 + L_2{}^3 + L_3{}^3 + ..L_N{}^3)}{(L_1 + L_2 + L_3 + ..L_N)}}$$

Where L_1, L_2, L_3, etc. are the lengths of the first, second, third, etc., spans between deadends.

Spans that are longer than 150% of the average should be avoided or should be sagged independently and guyed to hold the unbalanced tension. All new standard construction for tension should conform to the Company's design which limits tension to 50% of the conductor rated breaking strength by following the above mentioned ruling span calculation.

6.2.40 **Slack Spans**

When guys cannot be installed on the end pole of a line, they may be placed on an adjacent pole. A slack span should then be installed to the end pole. Slack spans may also be necessary for other applications. They are not recommended if there is any way of avoiding them, but when used, calculations should be made as follows:

$$\text{String Sag in Feet} = \frac{W \times L^2}{8 \times T}$$

W = Total loaded weight lbs./ft.
L = Total length of span in ft.
T = Tension in pounds. See Section 2-Poles / Hardware for strength required in poles.

Example:

50 foot span, 3-336.4 kcmil bare AAC to be deadended on an un-guyed Class 5 pole.
Use T = 200 lb. per conductor.

W = 1.48 lbs./foot (from Page 6-121)
L = 50 feet (span length)
T = 200 lbs.

Supersedes 1/07 Issue – Corrected page reference for conductor information.

$$S = \frac{W \times L^2}{8 \times T} = \frac{1.48 \times 50^2}{8 \times 200} = \frac{3700}{1600} = 2.3125\,Feet$$

Sag the conductor at 2.31 feet, at normal temperature. This approximation *assumes* that the conductors will have 2.31 feet of sag at 0˚F/-18˚C when subject to ice and wind.

6.3 MAXIMUM SPANS

Maximum spans, as shown in the table or on the pole top drawings, are based on many factors including: sag vs. pole height, transverse load vs. pole strength, vertical weight vs. strength of crossarms, and ratio of sag to separation of conductors. Spans are limited so that standard poles of reasonable height and class may be used for most work. They also are limited to reduce probability of wires coming together due to wind effects.

Span length should be limited to recommended values for all normal work. Longer spans may be used, except at railroad or major crossings, if clearances are adjusted accordingly. If longer spans are still essential, separate deadend spans should be designed by Standards Engineering to meet the field conditions.

6.4 AMPACITY

Current in overhead line conductors should be limited so that voltage drops will be held to reasonable values; so that conductors will not be severely annealed or damaged; so that switches, connectors, etc. will not be overloaded and that clearances are not exceeded. Any feeder that is desired to be operated at the elevated operating temperature permitted for emergency conditions should be assessed to verify that available clearances are present to account for the resulting additional sag as outlined in each respective conductor data table. Minimum clearances, outlined in Section 7 – Clearances, should not be compromised.

Table 2
Ampacity Design Parameters

SPECIFICATION	BARE CONDUCTOR	TREE WIRE
	SUMMER / WINTER	SUMMER / WINTER
Maximum Allowable Steady State Conductor Temperature (˚C) For Normal Operating Conditions	176˚F/80˚C	167˚F/75˚C
Maximum Allowable Steady State Conductor Temperature (˚C) For Emergency Contingencies	194˚F/90˚C	194˚F/90˚C
Ambient Air Temperature (˚C)	100˚F/37.7˚C / 50˚F/10˚C	100˚F/37.7˚C / 50˚F/10˚C
Wind Speed (FT. / SEC.)	3 FEET/SEC.	3 FEET/SEC.
Angle between Wind and Conductor	90˚	90˚
Coefficient of Emissivity	0.75	0.91
Coefficient of Absorption	0.75	0.91
Climatic Data Record (CDR) elevation above sea level (FT.)	914.2125 FEET	914.2125 FEET
Conductor Direction (North – South, East – West)	North – South	North – South
CDR Latitude in Degrees	42˚	42˚
Solar Heating	12:00 PM (noon)/NONE	12:00 PM (noon)/NONE
Atmosphere	CLEAR	CLEAR
Conductor Resistance in Ohm/mi. for the Low Temperature @ 77˚F/25˚C	Conductor Specific – In Accordance with Low Conductor Temperature	Conductor Specific – In Accordance with Low Conductor Temperature
Conductor Resistance in Ohm/mi. for the High Temperature @ 167˚F/75˚C	Conductor Specific – In Accordance with High Conductor Temperature	Conductor Specific – In Accordance with High Conductor Temperature

The “Normal” rating is the maximum rating for daily operation without encountering excessive loss of life, etc. and accounting for load cycles as well as ambient temperature cycles. Limits are based on allowable sags, clearance issues, and avoiding damage. The “Emergency” rating is the ultimate or maximum rating for a specific period of time, accounting for peak load cycle and ambient temperature cycles, without enduring excessive loss of life. Emergency ratings are applicable to short-term relief and should not exceed a 24 hour load cycle. For design purposes, emergency ratings exceeding a full load cycle were assumed resulting in a conductor rating that does not promote excessive loss of conductor life during such contingencies. This more conservative view was used for overhead conductors because of the concern for a permanent annealing of the conductor. For overhead conductors, such annealing could result in excess sag, and ultimately create clearance issues. In any case, the “Emergency” ampacity rating should not be exceeded nor allowed for prolonged duration in excess of 24 hours.

Primary overhead conductors have two (2) ampacity ratings for summer conditions and two (2) ampacity ratings for winter conditions as defined below:

Normal: The Normal rating shall be interpreted as the maximum value for normal peak loads on all new and rebuilt feeders. This is done to accommodate emergency conditions where ampacity may be increased for a period of time no greater than 24 hours. Existing feeders may be loaded to these levels if a review indicates that appropriate clearances can be maintained. (100% ampacity for normal operating conductor temperature limit; 176˚F/80˚C for bare conductors, 167˚F/75˚C for spacer cable / tree wire / covered conductors)

Emergency: The Emergency rating shall be interpreted as the absolute maximum ampacity allowed for a given conductor. This ampacity should not be exceeded under any condition unless an appropriate engineering review has been conducted. (100% ampacity for operating conductor at an elevated temperature during emergency conditions limited to a 24 hour period; 194˚F/90˚C for both bare and spacer cable / tree wire / covered conductors)

6.5 PLANNING CONDUCTOR INSTALLATIONS

6.5.10 General

Background knowledge of conductor sag and tensions, and ampacity are essential for all phases of planning, as well as determining the appropriate conductor, pole class and height, guy designs, etc. Designs will also be influenced by features that are discussed in specific Sections of these standards, including: Primaries, Street Lighting, and Secondaries.

The size for conductor should follow planning criteria or reviewed by a distribution system planning engineer. The distribution designer who selects the materials should furnish guidance to the field whenever it is required. For example, the distribution designer should furnish stringing sags at 32˚F/0˚C, 60˚F/15˚C, and 90˚F/32˚C and should indicate the spans that should be checked for sag whenever ruling span or slack span sag is needed.

For normal urban work refer to the standard tables, or curves, with variations discussed in Section 22-Materials Catalog.

6.5.20 Employment of 3,000 lb. Maximum Design Tension

Advantages of using design tensions greater than 2,000 lbs. may be substantial under certain circumstances. The advantages include reduced costs, avoiding need for intermediate poles when converting from single phase to three phase, and improved appearance resulting from fewer poles. If advantages like this are clearly evident, 3,000 lb. span construction may be used for three phase lines in rural areas where the presence of secondaries and telephone is minimal and future urbanization is not anticipated. Isolated situations where conventional construction results in excessive sag may also be justification for 3,000 lb. construction. Crossarm tangents, vertical construction, deadends, and 336.4 kcmil or 477 kcmil 18/1 bare ACSR conductors should be employed for 3000 lb construction. Heavy duty arms with gain plates should be used where vertical construction for line angle poles and double deadends are not practical. The 3,000 lb. section of line shall be isolated from 2,000 lb. line sections by proper longitudinal guys at each end.

6.5.30 Deadending Different Conductors

When different conductors are deadended from the opposite directions on the same pole, the load may be balanced under heavy load conditions but not under normal temperatures. Normal conditions must exist when the foreman installs the cable. Three 336.4 kcmil and one 1/0 ACSR conductors, for example, create an unbalanced load of about 8,000 lbs. under heavy loading conditions. One spacer cable messenger will almost balance this with a tension of 7,700 lbs. Under pre-stressed conditions, the spacer cable will be stressed to 5,000 lbs. The open wires, however, will have tensions not over 400 or 500 lbs. each or less than 2,000 lbs. total. For this reason, the spacer cable must be deadended and guyed against the stress. Similar conditions will be met when two small conductors are balanced against one large one. A head guy to the next pole will often be sufficient to take up small unbalanced loads.

6.6 INSTALLING CONDUCTORS

6.6.10 General

In order to obtain the desired tensions it is essential that the conductor be sagged correctly. This Standard has been prepared to guide the installation of conductors.

6.6.20 Sagging Open Wire Primaries – Long Span

For long span work or for special construction, the planner will usually select a ruling span, pick the span that should be sagged, choose the stringing sags, and show them on the construction drawing. If conditions in the field make it impractical to sag this span, the planner should be consulted and the new stringing sags provided.

6.6.30 Sagging Other Open Conductors

Where special conditions warrant, the planner may select the span to be sagged and choose the stringing sags. In many cases, however, the sags will not be specified. In these cases proceed as follows:

A. Choose a span of average length near the center of the section to be pulled.

B. Check the stringing sag tables for a span of that length at the temperature that can be expected during the sagging operations. If the exact span is not shown on the table, use the corresponding ratio multiplier found in Table 1 on Page 6-3 to determine the required value.

If the actual ruling span is not specified, choose a ruling span that is equal to, or slightly more than, the actual span.

If existing conductors are to be re-sagged or re-strung, see Part E below.

C. Pull up the entire section, equalizing tension in each span. Check the sag in the key span using a sagging stick or scale. Spans of other lengths will not necessarily have sags that match the stringing tables.

D. When different conductors are strung in parallel (e.g. on the same arm) string them to the value of the conductor with the greatest sag. It may be necessary to provide extra clearance for the wires so sagged.

E. When re-sagging or re-stringing old conductors, they should first be pulled tightly to sags somewhat less than final values, and then backed off to meet the final sag curves.

6.6.40 Line of Sight Method of Sagging Conductors

Select the longest span near the center of the line being sagged. Determine the proper stringing sag from the appropriate sag table. Measure down this distance “X” on both poles of the span from the height of the conductor attachment to the pole (see Figure 1 on Page 6-8). Attach a marker at this point that can be seen from the other pole. The conductor should be sagged to the line of sight between the two markers. The sag should be as close as practical to the stringing sag shown in the sag tables. Decreased sags cause tensions greater than design tensions and may overstress conductors, poles, crossarms and guys. Increased sags cause clearances smaller than design clearance.

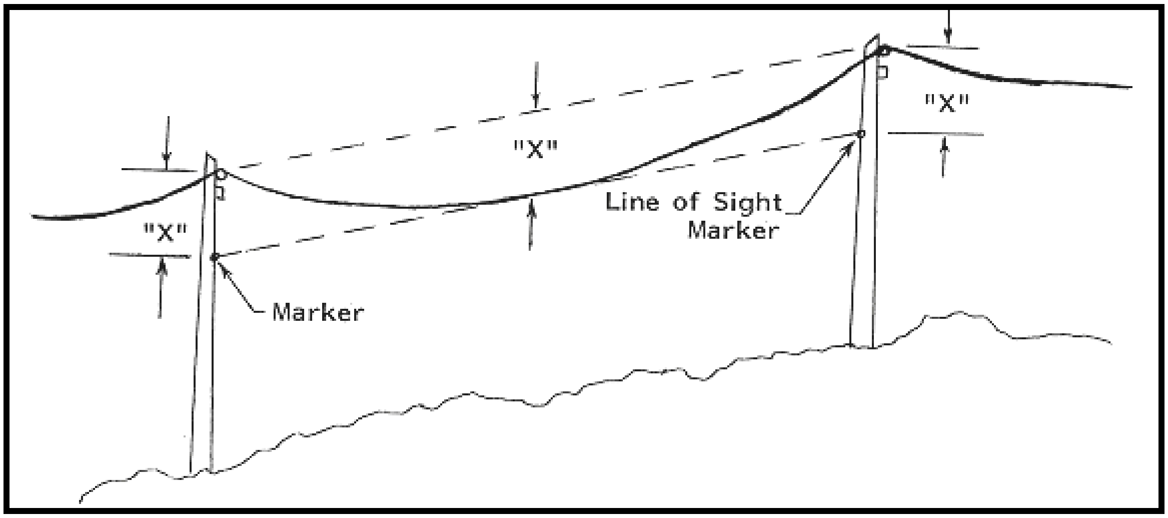


Figure 1 – Line of Sight Method of Sagging Conductors

Standard Overhead Distribution Conductors

Std. Item:	W21NG
Item ID:	9302828[E]
CU:	C1113ASSTBRNE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	39,100 lbs.	TRANSVERSE	0.7634 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.9854 sq. in.	VERTICAL	2.546 Lb/Ft			
R. (@ 25˚C)	0.0161 Ω / 1000’	TOTAL	2.958 Lb/Ft	1111	NORMAL	1614
R. (@ 75˚C)	0.0191 Ω / 1000’			1262	EMERGENCY	1709
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	24.33˚			
CONDUCTOR DIAMETER	1.293”					
WEIGHT	1430 lbs / 1000’					

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	2672	1772	1394	1162	2461	1810	1499	1287	2318	1837	1578	1389	2208	1857	1639	1471
ACTUAL SPAN (FEET)																
50	2	3	4	5	2	3	4	4	2	3	3	4	2	3	3	4
60	3	4	6	7	3	4	5	6	3	4	5	6	3	4	5	5
70	4	6	8	9	4	6	7	8	5	6	7	8	5	6	6	7
80	5	8	10	12	6	8	9	11	6	7	9	10	6	7	8	9
90	7	10	12	15	7	10	12	14	8	9	11	13	8	9	11	12
100	8	12	15	18	9	12	14	17	9	12	14	15	10	12	13	15
110	10	15	19	22	11	14	17	20	11	14	16	19	12	14	16	18
120	12	17	22	27	13	17	21	24	13	17	20	22	14	17	19	21
130	14	20	26	31	15	20	24	28	16	20	23	26	16	20	22	25
140	16	24	30	36	17	23	28	33	18	23	27	30	19	23	26	29
150	18	27	35	42	20	27	32	38	21	26	31	35	22	26	29	33
160	21	31	39	47	22	30	37	43	24	30	35	40	25	30	34	37
170	23	35	45	53	25	34	41	48	27	34	39	45	28	33	38	42
180	26	39	50	60	28	38	46	54	30	38	44	50	32	37	42	47
190	29	44	56	67	31	43	52	60	33	42	49	56	35	42	47	53
200	32	48	62	74	35	47	57	67	37	47	54	62	39	46	52	58
210	35	53	68	82	38	52	63	74	41	52	60	68	43	51	58	64
220	39	59	75	90	42	57	69	81	45	57	66	75	47	56	63	71
230	43	64	82	98	46	63	76	88	49	62	72	82	51	61	69	77
240	46	70	89	107	50	68	83	96	53	67	78	89	56	67	75	84
250	50	76	96	116	55	74	90	104	58	73	85	97	61	72	82	91
260	54	82	104	125	59	80	97	113	63	79	92	105	66	78	89	99
270	59	88	112	135	64	87	105	122	68	85	99	113	71	84	96	107
280	63	95	121	145	68	93	112	131	73	92	107	121	76	91	103	115
290	68	102	130	156	73	100	121	141	78	98	115	130	82	97	110	123
300	72	109	139	167	79	107	129	150	83	105	123	139	88	104	118	132

****** Simulated with a maximum tension of 4000 lbs. ******

Supersedes 1/07 Issue – Updated item ID.

Std. Item:	W21NG
Item ID:	9302828E
CU:	C1113ASSTBRNE

Supersedes 1/07 Issue – Updated item ID.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	1.44	4.20	7.20	8.64	9.84	11.28	11.88	12.48
75	3.84	8.28	12.12	14.40	16.08	18.00	18.84	19.68
100	7.68	13.44	18.00	21.36	23.40	25.68	26.76	27.84
125	13.32	20.04	25.08	29.28	31.68	34.44	35.64	36.84
150	20.64	27.84	33.24	38.40	41.16	44.16	45.60	46.92
175	29.40	36.96	42.72	48.36	51.72	55.08	56.64	58.08
200	39.72	47.40	53.52	59.52	63.48	67.08	68.76	70.32
225	51.48	59.28	65.64	71.76	76.44	80.28	81.96	83.76
250	64.56	72.60	79.08	85.44	90.48	94.68	96.48	98.28
275	79.08	87.24	93.84	100.44	105.60	110.28	112.20	114.12
300	95.04	103.20	109.92	116.64	122.04	127.08	129.12	131.16

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½" ICE	**½" ICE**	**6 LB. WIND**	**4 LB. WIND, ½" ICE**
DEAD END SPAN (FEET)				
50	2.76	5.16	7.32	*4000
75	6.24	9.60	12.24	*4000
100	11.04	15.24	18.12	*4000
125	17.28	22.08	25.20	*4000
150	24.96	30.12	33.48	*4000
175	33.96	39.48	43.08	*4000
200	44.40	50.16	53.88	*4000
225	56.16	62.16	65.88	*4000
250	69.36	75.60	79.32	*4000
275	84.00	90.24	94.08	*4000
300	99.96	106.32	110.28	*4000
** Note: Design Specification Constraint*				

****** Simulated with a maximum tension of 4000 lbs. ******

Std. Item:	W21NF
Item ID:	9306375[E]
CU:	C795ASSTBRNE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	28,200 lbs.	**TRANSVERSE**	0.6966 Lb/Ft	**SUMMER (37.7˚C)**	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
C.S.A.	0.7049 sq. in.	**VERTICAL**	2.015 Lb/Ft			
R. (@ 25˚C)	0.0222 Ω / 1000’	**TOTAL**	2.432 Lb/Ft	902	**NORMAL**	1299
R. (@ 75˚C)	0.0265 Ω / 1000’			1021	**EMERGENCY**	1375
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	**SWING**	28.14˚			
CONDUCTOR DIAMETER	1.093”					
WEIGHT	1022 lbs / 1000’					

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	2446	1557	1165	938	2192	1537	1228	1028	2004	1523	1274	1100	1874	1513	1310	1157
ACTUAL SPAN (FEET)																
50	2	2	3	4	2	2	3	4	2	3	3	3	2	3	3	3
60	2	4	5	6	3	4	5	5	3	4	4	5	3	4	4	5
70	3	5	6	8	3	5	6	7	4	5	6	7	4	5	6	7
80	4	6	8	10	4	6	8	10	5	6	8	9	5	6	8	8
90	5	8	11	13	6	8	10	12	6	8	10	11	7	8	10	11
100	6	10	13	16	7	10	13	15	8	10	12	14	8	10	12	13
110	8	12	16	20	8	12	15	18	9	12	15	17	10	12	14	16
120	9	14	19	24	10	14	18	22	11	15	17	20	12	15	17	19
130	11	17	22	28	12	17	21	25	13	17	20	24	14	17	20	22
140	12	19	26	32	14	20	25	29	15	20	24	27	16	20	23	26
150	14	22	30	37	16	22	28	34	17	23	27	31	18	23	26	30
160	16	25	34	42	18	26	32	38	20	26	31	36	21	26	30	34
170	18	29	38	47	20	29	36	43	22	29	35	40	24	29	34	38
180	20	32	43	53	23	32	41	48	25	333	39	45	27	33	38	43
190	23	36	48	59	25	36	45	54	28	36	44	50	30	37	42	48
200	25	39	53	66	28	40	50	60	31	40	48	56	33	41	47	53
210	28	44	58	72	31	44	55	66	34	45	53	62	36	45	52	59
220	30	48	64	79	34	48	61	72	37	49	58	68	40	49	57	64
230	33	52	70	87	37	53	66	79	41	53	64	74	43	54	62	70
240	36	57	76	94	40	58	72	86	44	58	69	81	47	59	68	77
250	39	62	82	103	44	62	78	94	48	63	75	87	51	63	73	83
260	42	67	89	111	47	68	85	101	52	68	82	95	55	69	79	90
270	46	71	96	120	51	73	91	109	56	74	88	102	60	74	59	97
280	49	77	103	129	55	78	98	117	60	79	95	110	64	80	92	104
290	53	83	111	138	59	84	105	126	64	85	101	118	69	85	99	112
300	57	89	119	148	63	90	113	135	69	91	109	126	74	91	106	120

****** Simulated with a maximum tension of 3500 lbs. ******

Supersedes 1/07 Issue – Updated item ID.

Std. Item:	W21NF
Item ID:	9306375[E]
CU:	C795ASSTBRNE

Supersedes 1/07 Issue – Updated item ID.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	1.20	3.00	6.00	7.68	9.00	10.44	11.16	11.76
75	3.00	6.36	10.44	13.20	14.88	16.92	17.76	18.72
100	5.88	11.16	15.84	19.68	21.72	24.24	25.32	26.40
125	10.56	17.04	22.44	27.12	29.52	32.40	33.72	35.04
150	16.92	24.36	30.12	35.52	38.40	41.64	43.08	44.52
175	24.96	32.88	39.00	44.88	48.36	51.84	53.40	55.08
200	34.44	42.60	49.08	55.20	59.28	63.12	64.92	66.60
225	45.36	53.76	60.36	66.84	71.40	75.48	77.40	79.20
250	57.72	66.12	72.96	79.68	84.72	89.04	90.96	93.00
275	71.28	79.92	86.76	93.72	99.24	103.80	105.84	107.76
300	86.28	94.92	101.88	109.08	114.84	119.64	121.80	123.84

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	2.64	4.32	6.12	*3500
75	5.88	8.40	10.68	*3500
100	10.44	13.80	16.20	*3500
125	16.32	20.16	22.80	*3500
150	23.40	27.84	30.48	*3500
175	31.92	36.72	39.36	*3500
200	41.76	46.80	49.56	*3500
225	52.80	58.08	60.84	*3500
250	65.16	70.68	73.56	*3500
275	78.84	84.48	87.36	*3500
300	93.84	99.60	102.48	*3500
** Note: Design Specification Constraint*				

****** Simulated with a maximum tension of 3500 lbs. ******

Std. Item:	W21BF
Item ID:	9302781[E]
CU:	C795ALSTBRNE

PHYSICAL PROPERTIES	
R.B.S.	13,900 lbs.
C.S.A.	0.6245 sq. in.
R. (@ 25˚C)	0.0227 Ω / 1000’
R. (@ 75˚C)	0.0269 Ω / 1000’
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	1.026”
WEIGHT	745 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.675 Lb/Ft
VERTICAL	1.694 Lb/Ft
TOTAL	2.124 Lb/Ft
SWING	34.54˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
880	NORMAL	1265
997	EMERGENCY	1339

Supersedes 7/15 Issue – Updated RBS, loading properties, sags, and tensions.

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	868	657	554	484	811	669	588	527	779	676	612	560	760	682	629	585
ACTUAL SPAN (FEET)																
50	3	4	5	6	3	4	5	5	4	4	5	5	4	4	4	5
60	5	6	7	8	5	6	7	8	5	6	7	7	5	6	6	7
70	6	8	10	11	7	8	9	10	7	8	9	10	7	8	9	9
80	8	11	13	15	9	11	12	14	9	11	12	13	9	11	11	12
90	10	14	16	19	11	14	15	17	12	13	15	16	12	13	14	16
100	13	17	20	23	14	17	19	21	14	17	18	20	15	16	18	19
110	16	21	24	28	17	20	23	26	17	20	22	24	18	20	22	23
120	19	25	29	33	20	24	27	31	21	24	26	29	21	24	26	28
130	22	29	34	39	23	28	32	36	24	28	31	34	25	28	30	32
140	25	33	40	45	27	33	37	42	28	33	36	39	29	32	35	38
150	29	38	45	52	31	38	43	48	32	37	41	45	33	37	40	43
160	33	44	52	59	35	43	49	54	37	42	47	51	38	42	46	49
170	37	49	58	67	40	48	55	61	42	48	53	58	43	48	51	55
180	42	55	65	75	45	54	62	69	47	54	59	65	48	53	58	62
190	47	62	73	83	50	60	69	77	52	60	66	72	53	59	64	69
200	52	68	81	92	55	67	76	85	58	66	73	80	59	66	71	77
210	57	75	89	102	61	74	84	94	63	73	81	88	65	73	79	85
220	62	82	98	112	67	81	92	103	70	80	89	97	71	80	86	93
230	68	90	107	122	73	89	101	113	76	88	97	106	78	87	94	102
240	74	98	116	133	80	96	110	123	83	96	106	115	85	95	103	111
250	81	107	126	144	86	105	119	133	90	104	115	125	92	103	111	120
260	87	115	137	156	93	113	129	144	97	112	124	135	100	111	120	130
270	94	124	147	169	101	122	139	155	105	121	134	146	108	120	130	140
280	101	134	158	181	108	131	149	167	113	130	144	157	116	129	140	151
290	109	143	170	194	116	141	160	179	121	139	154	168	124	138	150	161
300	116	153	182	208	124	151	171	192	129	149	165	180	133	148	160	173

Std. Item:	W21BF
Item ID:	9302781[E]
CU:	C795ALSTBRNE

Supersedes 7/15 Issue – Updated sags and tensions.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	1.92	5.64	5.86	8.88	11.28	13.44	15.60	16.56
75	6.00	11.16	11.43	15.24	18.60	21.48	24.60	26.04
100	12.84	18.60	18.91	23.28	27.24	30.72	34.68	36.48
125	21.96	27.84	28.18	33.00	37.44	41.40	46.08	48.12
150	33.00	39.12	39.48	44.52	49.32	53.76	58.92	61.20
175	46.08	52.20	52.58	57.84	63.00	67.80	73.44	75.96
200	61.08	67.32	67.71	73.20	78.48	83.52	89.64	92.28
225	78.24	84.48	84.87	90.36	96.00	101.28	107.52	110.40
250	97.32	103.68	104.08	109.68	115.32	120.72	127.32	130.32
275	118.44	124.80	125.21	130.92	136.68	142.32	149.04	152.16
300	141.60	147.96	148.38	154.20	160.08	165.72	172.80	175.92

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½" ICE	**½" ICE**	**6 LB. WIND**	**4 LB. WIND, ½" ICE**
DEAD END SPAN (FEET)				
50	4.08	6.84	9.00	*1948
75	9.36	12.84	15.48	*1921
100	16.56	20.64	23.52	*1924
125	25.80	30.12	33.24	*1935
150	36.96	41.64	44.76	*1945
175	50.04	54.84	58.20	*1954
200	65.16	70.20	73.56	*1962
225	82.20	87.36	90.72	*1968
250	101.40	106.56	110.04	*1973
275	122.52	127.80	131.28	*1977
300	145.68	151.08	154.56	*1980
** Note: Design Specification Constraint*				

Std. Item:	W21ND
Item ID:	9313225
CU:	C795ALTWHMP35KNE
CU:	C795ALSCHMP35KNE

PHYSICAL PROPERTIES	
R.B.S.	13,480 lbs.
C.S.A.	0.6245 sq. in.
R. (@ 25˚C)	0.0227 Ω / 1000’
R. (@ 75˚C)	0.0271 Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.932”
COMPLETE DIAMETER	1.572” (Nominal)
WEIGHT	1,315 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.857 Lb/Ft
VERTICAL	2.603 Lb/Ft
TOTAL	3.041 Lb/Ft
SWING	30.87˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
669	NORMAL	952
828	EMERGENCY	1058

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	942	827	752	691	917	837	781	732	903	844	801	761	894	849	814	782
ACTUAL SPAN (FEET)																
50	5	6	7	7	5	6	6	7	5	6	6	7	6	6	6	6
60	8	9	9	10	8	9	9	10	8	8	9	9	8	8	9	9
70	10	12	13	14	11	12	12	13	11	12	12	13	11	11	12	12
80	13	15	17	18	14	15	16	17	14	15	16	17	14	15	16	16
90	17	19	21	23	17	19	21	22	18	19	20	21	18	19	20	21
100	21	24	26	29	22	24	25	27	22	23	25	26	22	23	24	25
110	25	29	32	35	26	29	31	33	27	28	30	32	27	28	30	31
120	30	34	38	41	31	34	36	39	32	34	36	38	32	34	35	37
130	35	40	44	48	36	40	43	46	37	40	42	44	38	40	41	43
140	41	47	51	56	42	46	50	53	43	46	49	51	44	46	48	50
150	47	54	59	64	48	53	57	61	49	53	56	59	50	53	55	57
160	54	61	67	73	55	61	65	69	56	60	63	67	57	60	62	65
170	61	69	76	83	62	68	73	78	63	68	72	75	64	68	70	73
180	68	77	85	93	70	77	82	88	71	76	80	84	72	76	79	82
190	76	86	95	103	78	85	91	98	79	85	89	94	80	84	88	92
200	84	96	105	115	86	95	101	108	88	94	99	104	89	94	98	102
210	92	105	116	126	95	104	112	119	97	104	109	115	98	103	108	112
220	101	116	127	139	104	114	123	131	106	114	120	126	107	113	118	123
230	111	126	139	152	114	125	134	143	116	124	131	138	117	124	129	134
240	121	138	151	165	124	136	146	156	126	135	143	150	128	135	140	146
250	131	149	164	179	135	148	158	169	137	147	155	163	139	146	152	159
260	142	162	178	194	146	160	171	183	148	159	167	176	150	158	165	172
270	153	174	191	209	157	172	185	198	160	171	181	190	162	170	178	185
280	164	187	206	225	169	185	199	212	172	184	194	204	174	183	191	199
290	176	201	221	241	181	199	213	228	185	198	208	219	187	197	205	214
300	189	215	236	258	194	213	228	244	197	211	223	235	200	210	220	229

Supersedes 7/15 Issue – Updated RBS, loading properties, sags, and tensions.

Std. Item:	W21ND
Item ID:	9313225
CU:	C795ALTWHMP35KNE
CU:	C795ALSCHMP35KNE

Supersedes 7/15 Issue – Updated sags and teensions.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	3.84	7.20	7.38	9.96	12.24	14.16	16.32	17.16
75	10.56	14.64	14.86	18.00	20.88	23.40	26.40	27.60
100	20.88	25.08	25.33	28.80	32.04	35.04	38.64	40.20
125	34.08	38.28	38.54	42.24	45.84	49.20	53.16	54.84
150	50.04	54.36	54.62	58.32	62.16	65.76	70.08	72.00
175	68.76	73.20	73.47	77.28	81.24	85.08	89.64	91.68
200	90.48	94.92	95.20	99.12	103.20	107.16	111.84	114.12
225	115.08	119.52	119.81	123.84	128.04	132.00	136.92	139.20
250	142.68	147.12	147.41	151.44	155.76	159.84	164.88	167.28
275	173.28	177.72	178.02	182.16	186.36	190.56	195.72	198.12
300	206.88	211.44	211.73	215.76	220.08	224.28	229.56	232.08

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	5.76	8.28	10.08	*2000
75	12.84	15.96	18.12	*2000
100	23.16	26.64	28.92	*1973
125	36.36	39.96	42.36	*1967
150	52.32	56.16	58.56	*1969
175	71.16	75.00	77.52	*1973
200	92.88	96.84	99.36	*1977
225	117.48	121.44	124.08	*1981
250	145.08	149.16	151.80	*1984
275	175.68	179.76	182.40	*1986
300	209.28	213.36	216.12	*1988
** Note: Design Specification Constraint*				

Std. Item:	W21BG
Item ID:	9313226
CU:	C795ALTWHMPNE
CU:	C795ALSCHMPNE

PHYSICAL PROPERTIES	
R.B.S.	13,480 lbs.
C.S.A.	0.6245 sq. in.
R. (@ 25˚C)	0.0227 Ω / 1000’
R. (@ 75˚C)	0.0271 Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.932”
COMPLETE DIAMETER	1.292” (Nominal)
WEIGHT	1,049 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.764 Lb/Ft
VERTICAL	2.163 Lb/Ft
TOTAL	2.594 Lb/Ft
SWING	31.63˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
714	**NORMAL**	1005
881	**EMERGENCY**	1118

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	916	766	677	609	881	777	709	653	861	785	731	685	848	790	747	708
ACTUAL SPAN (FEET)																
50	4	5	6	6	4	5	6	6	5	5	5	6	5	5	5	6
60	6	7	8	9	6	7	8	9	7	7	8	8	7	7	8	8
70	8	10	11	13	9	10	11	12	9	10	11	11	9	10	10	11
80	11	13	15	17	11	13	14	15	12	13	14	15	12	13	14	14
90	14	17	19	21	14	16	18	20	15	16	17	19	15	16	17	18
100	17	21	23	26	18	20	22	24	18	20	22	23	19	20	21	22
110	21	25	28	31	22	25	27	29	22	24	26	28	23	24	26	27
120	25	30	34	37	26	29	32	35	26	29	31	33	27	29	30	32
130	29	35	39	44	30	34	38	41	31	34	36	39	31	34	36	38
140	34	40	46	51	35	40	44	47	36	39	42	45	37	39	41	44
150	39	46	52	58	40	46	50	54	41	45	49	52	42	45	48	50
160	44	53	60	66	46	52	57	62	47	52	55	59	48	51	54	57
170	50	60	67	75	52	59	64	70	53	58	62	67	54	58	61	65
180	56	67	75	84	58	66	72	78	59	65	70	75	60	65	69	72
190	62	74	84	93	64	73	80	87	66	73	78	83	67	72	76	81
200	69	82	93	104	71	81	89	97	73	81	86	92	75	80	85	89
210	76	91	103	114	79	90	98	107	81	89	95	102	82	88	93	98
220	83	100	113	125	86	98	108	117	89	97	104	112	90	97	102	108
230	91	109	123	137	95	107	118	128	97	106	114	122	99	106	112	118
240	99	119	134	149	103	117	128	139	106	116	124	133	107	115	122	129
250	108	129	145	162	112	127	139	151	115	126	135	144	116	125	132	140
260	116	139	157	175	121	137	150	164	124	136	146	156	126	135	143	151
270	125	150	170	189	130	148	162	177	134	147	157	168	136	146	154	163
280	135	162	182	203	140	159	174	190	144	158	169	181	146	157	166	175
290	145	173	196	218	150	171	187	204	154	169	182	194	157	168	178	188
300	155	186	209	233	161	183	200	218	165	181	194	208	168	180	190	201

Supersedes 7/15 Issue – Updated RBS, loading properties, sags, and tensions.

795.0 KCMIL,19 STRAND, COMPACT AAC, 180 MIL COVERED TREE WIRE – 15 kV

Std. Item:	W21BG
Item ID:	9313226
CU:	C795ALTWHMPNE
CU:	C795ALSCHMPNE

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	2.88	6.48	6.68	9.48	11.76	13.80	15.96	16.92
75	8.28	12.84	13.09	16.56	19.68	22.32	25.44	26.76
100	16.68	21.48	21.76	25.68	29.28	32.64	36.36	38.04
125	27.72	32.76	33.06	37.20	41.28	44.88	49.20	51.12
150	41.40	46.56	46.86	51.12	55.44	59.40	64.20	66.24
175	57.48	62.64	62.96	67.44	71.88	76.20	81.24	83.52
200	76.08	81.24	81.56	86.04	90.72	95.16	100.44	102.96
225	96.96	102.24	102.57	107.16	111.96	116.52	122.04	124.56
250	120.48	125.64	125.98	130.68	135.48	140.16	145.92	148.56
275	146.40	151.68	152.02	156.72	161.64	166.44	172.32	174.96
300	174.96	180.24	180.58	185.28	190.32	195.12	201.12	203.88

Supersedes 7/15 Issue – Updated sags and tensions.

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.92	7.56	9.48	*2000
75	10.92	14.28	16.68	*2000
100	19.44	23.28	25.92	*2000
125	30.60	34.68	37.44	*1987
150	44.28	48.60	51.48	*1980
175	60.36	64.80	67.68	*1979
200	78.96	83.40	86.40	*1981
225	99.96	104.40	107.40	*1983
250	123.36	127.92	131.04	*1985
275	149.40	153.96	157.08	*1987
300	177.84	182.52	185.64	*1988
** Note: Design Specification Constraint*				

Std. Item:	
Item ID:	9302780
CU:	C477BACSR

PHYSICAL PROPERTIES	
R.B.S.	19,500 lbs.
C.S.A.	0.4353 sq. in.
R. (@ 25˚C)	0.0366 Ω / 1000’
R. (@ 75˚C)	0.0438 Ω / 1000’
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.858” (Nominal)
WEIGHT	656 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.6174 Lb/Ft
VERTICAL	1.501 Lb/Ft
TOTAL	1.923 Lb/Ft
SWING	33.18˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
658	NORMAL	938
742	EMERGENCY	991

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	2200	1333	913	691	1936	1255	937	750	1707	1200	954	796	1533	1161	967	832
ACTUAL SPAN (FEET)																
50	1	2	3	4	1	2	3	3	1	2	3	3	2	2	3	3
60	2	3	4	5	2	3	4	5	2	3	4	4	2	3	4	4
70	2	4	5	7	2	4	5	6	3	4	5	6	3	4	5	6
80	3	5	7	9	3	5	7	8	4	5	7	8	4	5	7	8
90	4	6	9	12	4	6	9	11	5	7	8	10	5	7	8	10
100	4	7	11	14	5	8	11	13	6	8	10	12	6	8	10	12
110	5	9	13	17	6	9	13	16	7	10	12	15	8	10	12	14
120	6	11	16	21	7	11	15	19	8	12	15	18	9	12	15	17
130	8	12	18	24	9	13	18	22	10	14	17	21	11	14	17	20
140	9	14	21	28	10	15	21	26	11	16	20	24	13	17	20	23
150	10	17	24	32	11	18	24	30	13	18	23	28	14	19	23	27
160	11	19	28	36	13	20	27	34	15	21	26	32	16	22	26	30
170	13	21	31	41	15	23	30	38	17	24	30	36	19	25	29	34
180	14	24	35	46	16	25	34	43	19	27	33	40	21	27	33	38
190	16	27	39	51	18	28	38	47	21	30	37	45	23	31	37	43
200	18	30	43	57	20	31	42	53	23	33	41	50	26	34	41	47
210	20	33	48	63	22	35	46	58	25	36	45	55	28	37	45	52
220	22	36	52	69	25	38	51	64	28	40	50	60	31	41	49	57
230	24	39	57	75	27	41	56	69	31	43	55	65	34	45	54	63
240	26	43	62	82	29	45	61	76	33	47	59	71	37	49	59	68
250	28	46	67	89	32	49	66	82	36	51	64	77	40	53	64	74
260	30	50	73	96	34	53	71	89	39	55	70	84	43	57	69	80
270	33	54	79	104	37	57	77	96	42	60	75	90	47	62	74	86
280	35	58	85	112	40	61	82	103	45	64	81	97	50	66	80	93
290	38	62	91	120	43	66	88	111	48	69	87	104	54	71	86	100
300	40	66	97	128	46	71	95	118	52	74	93	111	58	76	92	107

****** Simulated with a maximum tension of 3000 lbs. ******

Supersedes 7/15 Issue – Corrected normal temperature limit.

Std. Item:	
Item ID:	9302780
CU:	C477BACSR

Supersedes 1/07 Issue – Updated item ID.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.84	1.8	4.44	6.12	7.68	9.36	10.08	10.68
75	2.16	4.32	8.28	10.92	12.84	15.12	16.08	17.04
100	4.2	8.16	13.2	16.68	19.08	21.72	23.04	24.12
125	7.44	13.32	19.08	23.4	26.16	29.28	30.72	32.04
150	12.36	19.68	26.04	31.20	34.20	37.68	39.24	40.92
175	19.08	27.48	34.08	39.96	43.20	47.04	48.84	50.52
200	27.48	36.36	43.32	49.80	53.28	57.36	59.28	61.20
225	37.44	46.56	53.64	60.72	64.32	68.76	70.80	72.84
250	48.72	57.96	65.28	72.48	76.56	81.24	83.40	85.44
275	61.20	70.56	78.00	85.44	89.76	94.68	96.96	99.12
300	75.00	84.36	91.92	99.48	104.28	109.32	111.60	113.88

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	2.40	3.48	4.68	3000*
75	5.40	7.20	8.64	3000*
100	9.60	12.00	13.68	3000*
125	15.00	18.00	19.68	3000*
150	21.60	24.96	26.64	3000*
175	29.52	33.12	34.80	3000*
200	38.52	42.48	44.16	3000*
225	48.72	52.92	54.60	3000*
250	60.12	64.44	66.12	3000*
275	72.72	77.28	78.96	3000*
300	86.64	91.20	92.88	3000*
** Note: Design Specification Constraint*				

****** Simulated with a maximum tension of 3000 lbs. ******

Std. Item:	W21BA
Item ID:	9314655
CU:	C477ALSTBR

PHYSICAL PROPERTIES	
R.B.S.	8,360 lbs.
C.S.A.	0.3744 sq. in.
R. (@ 25˚C)	0.0373 Ω / 1000’
R. (@ 75˚C)	0.0445 Ω / 1000’
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.792”
WEIGHT	447 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.598 Lb/Ft
VERTICAL	1.251 Lb/Ft
TOTAL	1.686 Lb/Ft
SWING	41.59˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
640	NORMAL	908
721	EMERGENCY	960

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	1087	622	451	363	886	593	469	394	766	576	483	419	696	566	492	438
ACTUAL SPAN (FEET)																
50	2	3	4	5	2	3	4	4	2	3	3	4	2	3	3	4
60	2	4	5	7	3	4	5	6	3	4	5	6	3	4	5	6
70	3	5	7	9	4	6	7	8	4	6	7	8	5	6	7	8
80	4	7	10	12	5	7	9	11	6	7	9	10	6	8	9	10
90	5	9	12	15	6	9	12	14	7	9	11	13	8	10	11	12
100	6	11	15	19	8	11	14	17	9	12	14	16	10	12	14	15
110	7	13	18	22	9	14	17	21	11	14	17	19	12	14	17	19
120	9	16	21	27	11	16	21	24	13	17	20	23	14	17	20	22
130	10	18	25	31	13	19	24	29	15	20	24	27	16	20	23	26
140	12	21	29	36	15	22	28	33	17	23	27	31	19	23	27	30
150	14	24	34	42	17	26	32	38	20	26	31	36	22	27	31	35
160	16	28	38	47	19	29	37	44	22	30	36	41	25	30	35	39
170	18	31	43	53	22	33	41	49	25	34	40	46	28	34	39	44
180	20	35	48	60	25	37	46	55	28	38	45	52	31	39	44	50
190	22	39	54	67	27	41	52	61	32	42	50	58	35	43	49	55
200	25	44	60	74	30	45	57	68	35	47	56	64	39	48	55	61
210	27	48	66	82	33	50	63	75	39	52	61	71	42	52	60	68
220	30	53	72	90	37	55	69	82	42	57	67	78	47	58	66	74
230	33	58	79	98	40	60	76	90	46	62	74	85	51	63	72	81
240	35	63	86	107	44	65	82	98	51	67	80	92	55	68	79	88
250	38	68	93	116	47	71	89	106	55	73	87	100	60	74	85	96
260	42	74	101	125	51	77	97	115	59	79	94	108	65	80	92	104
270	45	79	109	135	55	83	104	124	64	85	101	117	70	87	100	112
280	48	85	117	145	59	89	112	133	69	92	109	126	75	93	107	120
290	52	92	125	156	64	96	120	143	74	98	117	135	81	100	115	129
300	55	98	134	167	68	102	129	153	79	105	125	144	87	107	123	138

Supersedes 7/15 Issue – Updated RBS, loading properties, sags, and tensions.

477.0 KCMIL, 19 STRAND, BARE AAC, “COSMOS” – 15 kV

Std. Item:	W21BA
Item ID:	9314655
CU:	C477ALSTBR

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	0.96	2.64	2.90	6.60	9.60	11.88	14.40	15.48
75	2.52	6.24	6.59	11.52	15.48	18.84	22.32	23.88
100	5.52	11.64	12.04	17.64	22.56	26.64	31.08	33.00
125	11.16	18.72	19.15	25.20	30.72	35.40	40.68	42.96
150	19.20	27.36	27.82	34.32	40.20	45.48	51.48	54.12
175	29.40	37.68	38.16	44.88	51.24	56.88	63.48	66.36
200	41.52	49.80	50.29	57.12	63.84	69.84	76.92	80.04
225	55.20	63.48	63.98	70.92	77.76	84.12	91.56	94.92
250	70.44	78.72	79.22	86.28	93.36	99.96	107.64	111.24
275	87.24	95.52	96.03	103.20	110.40	117.12	125.28	128.88
300	105.60	113.88	114.40	121.68	129.00	135.96	144.24	148.08

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½" ICE	**½" ICE**	**6 LB. WIND**	**4 LB. WIND, ½" ICE**
DEAD END SPAN (FEET)				
50	3.12	4.80	6.84	*2000
75	7.08	9.60	11.88	*2000
100	12.60	15.84	18.24	*2000
125	19.80	23.40	25.92	*2000
150	28.44	32.52	35.04	*2000
175	38.88	43.08	45.72	*1996
200	50.88	55.44	57.96	*1989
225	64.56	69.24	71.88	*1987
250	79.80	84.60	87.24	*1986
275	96.60	101.52	104.16	*1986
300	114.96	120.00	122.64	*1987

** Note: Design Specification Constraint*

Supersedes 7/15 Issue – Updated sags and tensions.

Std. Item:	W21NB
Item ID:	9313248[E]
CU:	C477ALTWHMP35KNE
CU:	C477ALSCHMP35KNE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	8,360 lbs.	TRANSVERSE	0.787 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.3746 sq. in.	VERTICAL	2.061 Lb/Ft			
R. (@ 25˚C)	0.0373 Ω / 1000’	TOTAL	2.506 Lb/Ft	489	NORMAL	692
R. (@ 75˚C)	0.0447 Ω / 1000’			603	EMERGENCY	768
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	37.02˚			
CONDUCTOR DIAMETER	0.722”					
COMPLETE DIAMETER	1.362” (Nominal)					
WEIGHT	903 lbs / 1000’					

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	931	749	646	572	859	740	665	605	818	735	678	630	793	732	687	647
ACTUAL SPAN (FEET)																
50	4	5	5	6	4	5	5	6	4	5	5	5	4	5	5	5
60	5	7	8	9	6	7	7	8	6	7	7	8	6	7	7	8
70	7	9	10	12	8	9	10	11	8	9	10	11	8	9	10	10
80	9	12	13	15	10	12	13	14	11	12	13	14	11	12	13	13
90	12	15	17	19	13	15	17	18	13	15	16	17	14	15	16	17
100	15	18	21	24	16	18	20	22	17	18	20	22	17	19	20	21
110	18	22	25	29	19	22	25	27	20	22	24	26	21	23	24	25
120	21	26	30	34	23	26	29	32	24	27	29	31	25	27	29	30
130	25	31	35	40	27	31	35	38	28	31	34	36	29	31	33	36
140	29	36	41	47	31	36	40	44	32	36	39	42	34	36	39	41
150	33	41	47	53	36	41	46	51	37	42	45	49	39	42	45	47
160	37	47	54	61	40	47	52	57	42	47	51	55	44	48	51	54
170	42	53	61	69	46	53	59	65	48	53	58	62	50	54	57	61
180	47	59	68	77	51	59	66	73	54	60	65	70	56	60	64	68
190	53	66	76	86	57	66	74	81	60	67	72	78	62	67	71	76
200	58	73	84	95	63	73	82	90	66	74	80	86	69	74	79	84
210	64	80	92	105	70	81	90	99	73	82	88	95	76	82	87	93
220	71	88	101	115	76	89	99	109	80	89	97	104	83	90	96	102
230	77	96	111	126	84	97	108	119	88	98	106	114	91	98	105	111
240	84	105	121	137	91	106	118	129	95	106	116	124	99	107	114	121
250	91	114	131	148	99	115	128	140	104	116	125	135	107	116	124	131
260	99	123	142	160	107	124	138	152	112	125	136	146	116	126	134	142
270	106	132	153	173	115	134	149	164	121	135	146	157	125	136	144	153
280	114	142	164	186	124	144	160	176	130	145	157	169	134	146	155	165
290	123	153	176	200	133	154	172	189	139	155	169	182	144	156	167	177
300	131	164	189	214	142	165	184	202	149	166	181	194	154	167	178	189

Supersedes 7/15 Issue – Updated RBS, loading properties, sags, and tensions.

477.0 KCMIL, 19 STRAND, COMPACT AAC, 320 MIL COVERED TREE WIRE – 35 kV

Std. Item:	W21NB
Item ID:	9313248[E]
CU:	C477ALTWHMP35KNE
CU:	C477ALSCHMP35KNE

Supersedes 7/15 Issue – Updated sags and tesnison.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	2.16	4.68	4.90	7.92	10.44	12.60	15.00	15.96
75	6.84	11.16	11.42	15.00	18.24	21.12	24.24	25.68
100	15.00	19.92	20.21	24.24	27.96	31.32	35.16	36.84
125	25.80	30.96	31.26	35.52	39.60	43.44	47.76	49.68
150	39.00	44.16	44.48	48.96	53.40	57.48	62.28	64.44
175	54.48	59.76	60.09	64.68	69.36	73.68	78.84	81.12
200	72.36	77.76	78.09	82.68	87.48	92.04	97.44	99.96
225	92.64	98.04	98.38	103.08	108.00	112.68	118.32	120.96
250	115.32	120.72	121.06	125.88	130.80	135.60	141.48	144.24
275	140.40	145.80	146.14	150.96	156.00	160.92	166.92	169.80
300	167.88	173.28	173.63	178.56	183.72	188.64	194.88	197.64

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.68	6.60	8.16	*2000
75	10.92	13.68	15.36	*1928
100	19.68	22.80	24.60	*1909
125	30.72	34.08	36.00	*1914
150	44.04	47.64	49.56	*1925
175	59.64	63.36	65.28	*1937
200	77.52	81.48	83.40	*1946
225	97.92	101.88	103.80	*1955
250	120.60	124.56	126.48	*1961
275	145.68	149.76	151.68	*1967
300	173.16	177.36	179.28	*1971
** Note: Design Specification Constraint*				

Std. Item:	W21BD
Item ID:	9302808
CU:	C477ALTWHMPNE
CU:	C477ALSCHMPNE

PHYSICAL PROPERTIES	
R.B.S.	8,360 lbs.
C.S.A.	0.3744 sq. in.
R. (@ 25˚C)	0.0373 Ω / 1000’
R. (@ 75˚C)	0.0447 Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.722”
COMPLETE DIAMETER	1.042” (Nominal)
WEIGHT	637 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.681 Lb/Ft
VERTICAL	1.596 Lb/Ft
TOTAL	2.035 Lb/Ft
SWING	39.28˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
528	NORMAL	739
647	EMERGENCY	819

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	973	679	546	462	848	664	566	496	778	654	579	521	737	647	589	541
ACTUAL SPAN (FEET)																
50	2	4	4	5	3	4	4	5	3	4	4	5	3	4	4	4
60	4	5	6	7	4	5	6	7	4	5	6	7	5	5	6	6
70	5	7	9	10	6	7	8	9	6	7	8	9	6	7	8	9
80	6	9	11	13	7	9	11	12	8	9	11	12	8	9	10	11
90	8	11	14	17	9	12	14	16	10	12	13	15	11	12	13	14
100	10	14	18	21	11	14	17	19	12	15	17	18	13	15	16	18
110	12	17	21	25	14	18	20	23	15	18	20	22	16	18	20	21
120	14	20	25	30	16	21	24	28	18	21	24	26	19	21	23	26
130	17	24	30	35	19	24	29	33	21	25	28	31	22	25	28	30
140	19	28	34	41	22	28	33	38	24	29	32	36	25	29	32	35
150	22	32	39	47	25	33	38	43	28	33	37	41	29	33	37	40
160	25	36	45	53	29	37	43	49	31	38	42	47	33	38	42	45
170	28	41	51	60	33	42	49	56	36	42	48	53	38	43	47	51
180	32	46	57	67	36	47	55	63	40	48	54	60	42	48	53	57
190	35	51	63	75	41	52	61	70	44	53	60	66	47	53	59	64
200	39	57	70	83	45	58	68	77	49	59	66	74	52	59	65	71
210	43	62	77	91	50	64	75	85	54	65	73	81	57	65	72	78
220	48	68	85	100	54	70	82	93	60	71	80	89	63	72	79	86
230	52	75	93	110	60	77	89	102	65	78	87	97	69	78	86	94
240	57	81	101	119	65	83	97	111	71	85	95	106	75	85	94	102
250	61	88	109	130	70	90	106	121	77	92	103	115	81	93	102	111
260	66	96	118	140	76	98	114	131	83	99	112	124	88	100	110	120
270	72	103	128	151	82	105	123	141	90	107	121	134	95	108	119	129
280	77	111	137	163	88	113	133	151	96	115	130	144	102	116	128	139
290	83	119	147	174	95	122	142	162	103	123	139	155	109	125	137	149
300	88	127	158	187	101	130	152	174	111	132	149	165	117	133	147	160

Supersedes 7/15 Issue – Updated RBS, loading properties, sags, and tensions.

477.0 KCMIL, 19 STRAND, COMPACT AAC, 160 MIL COVERED TREE WIRE – 15 kV

Std. Item:	W21BD
Item ID:	9302808
CU:	C477ALTWHMPNE
CU:	C477ALSCHMPNE

Supersedes 7/15 Issue – Updated sags and tensions.

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	1.44	3.60	3.83	7.08	9.96	12.24	14.64	15.60
75	3.96	8.28	8.58	12.72	16.44	19.56	22.92	24.48
100	9.24	15.12	15.46	20.28	24.60	28.32	32.52	34.44
125	17.76	24.12	24.49	29.64	34.44	38.64	43.56	45.72
150	28.44	35.04	35.42	40.80	45.84	50.52	56.04	58.44
175	41.04	47.64	48.04	53.64	59.04	64.08	69.96	72.60
200	55.56	62.28	62.69	68.40	74.04	79.32	85.56	88.32
225	72.00	78.72	79.14	84.96	90.72	96.24	102.84	105.84
250	90.36	97.08	97.50	103.44	109.32	115.08	121.92	125.04
275	110.76	117.36	117.79	123.84	129.84	135.72	142.80	146.04
300	132.96	139.68	140.10	146.04	152.28	158.28	165.48	168.84

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½" ICE	**½" ICE**	**6 LB. WIND**	**4 LB. WIND, ½" ICE**
DEAD END SPAN (FEET)				
50	3.84	5.64	7.32	*2000
75	8.64	11.16	13.20	*2000
100	15.48	18.60	20.76	*1976
125	24.48	28.08	30.24	*1954
150	35.28	39.12	41.40	*1950
175	48.00	52.08	54.36	*1952
200	62.52	66.84	69.12	*1956
225	79.08	83.40	85.68	*1961
250	97.44	101.88	104.16	*1966
275	117.84	122.28	124.56	*1970
300	140.04	144.60	147.00	*1973

** Note: Design Specification Constraint*

Std. Item:	TC52
Item ID:	9315752
CU:	C33ASSTBR

PHYSICAL PROPERTIES	
R.B.S.	8,700 lbs.
C.S.A.	0.2789 sq. in.
R. (@ 25˚C)	0.0523 Ω / 1000’
R. (@ 75˚C)	0.0625 Ω / 1000’
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.684”
WEIGHT	365 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.5617 Lb/Ft
VERTICAL	1.101 Lb/Ft
TOTAL	1.536 Lb/Ft
SWING	43.14˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
519	NORMAL	733
584	EMERGENCY	775

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	2400	1624	972	552	2449	1690	1063	643	2398	1655	1072	693	2217	1503	1001	696
ACTUAL SPAN (FEET)																
50	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2
60	1	1	2	4	1	1	2	3	1	1	2	3	1	1	2	3
70	1	2	3	5	1	2	3	4	1	2	3	4	1	2	3	4
80	1	2	4	6	1	2	3	5	1	2	3	5	2	2	3	5
90	2	3	5	8	2	3	4	7	2	3	4	6	2	3	4	6
100	2	3	6	10	2	3	5	9	2	3	5	8	2	4	5	8
110	3	4	7	12	3	4	6	10	3	4	6	10	3	4	7	10
120	3	5	8	14	3	5	7	12	3	5	7	11	4	5	8	11
130	4	6	10	17	4	5	9	14	4	6	9	13	4	6	9	13
140	4	7	11	19	4	6	10	17	4	6	10	15	5	7	11	15
150	5	8	13	22	5	7	12	19	5	7	11	18	6	8	12	18
160	6	9	14	25	6	8	13	22	6	8	13	20	6	9	14	20
170	7	10	16	29	6	9	15	25	7	10	15	23	7	11	16	23
180	7	11	18	32	7	10	17	28	7	11	17	26	8	12	18	25
190	8	12	20	36	8	12	19	31	8	12	18	29	9	13	20	28
200	9	13	23	40	9	13	21	34	9	13	20	32	10	15	22	31
210	10	15	25	44	10	14	23	38	10	15	23	35	11	16	24	35
220	11	16	27	48	11	16	25	41	11	16	25	38	12	18	26	38
230	12	18	30	53	12	17	27	45	12	17	27	42	13	19	29	42
240	13	19	32	57	13	19	30	49	13	19	29	46	14	21	32	45
250	14	21	35	62	14	20	32	53	14	21	32	49	15	23	34	49
260	15	23	38	67	15	22	35	58	15	22	35	53	17	25	37	53
270	17	25	41	72	16	24	38	62	17	24	37	58	18	27	40	57
280	18	26	44	78	18	25	40	67	18	26	40	62	19	29	43	62
290	19	28	47	84	19	27	43	72	19	28	43	67	21	31	46	66
300	21	30	51	89	20	29	46	77	21	30	46	71	22	33	49	71

Supersedes 7/09 Issue – Updated item ID.

****** Simulated with a maximum tension of 3000 lbs. ******

336.4 KCMIL, 18/1 STRANDING, BARE ACSR, “MERLIN” – 15 kV

Std. Item:	TC52
Item ID:	9315752
CU:	C33ASSTBR

Supersedes 7/09 Issue – Updated item ID.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.60	1.20	3.24	6.96	8.40	9.84	10.44	11.04
75	1.44	2.64	6.00	10.92	13.92	15.84	16.68	17.52
100	2.52	4.56	9.12	15.12	20.04	22.32	23.40	24.48
125	3.96	6.96	12.60	19.68	25.56	29.40	30.60	31.80
150	5.64	9.72	16.44	24.36	31.32	36.84	38.16	39.60
175	8.04	13.56	21.48	30.24	37.92	45.24	46.80	48.24
200	11.64	19.32	28.44	37.80	45.96	54.96	56.76	58.44
225	16.68	26.40	36.36	46.20	54.84	64.56	67.56	69.36
250	23.16	34.80	45.36	55.56	64.68	74.88	79.08	81.00
275	31.44	44.40	55.32	65.76	75.24	86.04	90.84	93.36
300	41.40	55.08	66.24	77.04	86.76	98.04	102.96	106.68

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	2.52	3.12	3.84	2291
75	5.40	6.36	6.84	2414
100	9.00	10.20	10.32	2553
125	13.32	14.64	14.28	2700
150	18.24	19.44	18.48	2849
175	24.00	25.32	23.88	*2936
200	31.32	32.76	31.08	*2948
225	39.48	41.04	39.12	*2958
250	48.60	50.28	48.24	*2965
275	58.68	60.48	58.20	*2971
300	69.72	71.52	69.24	*2976
* Note: Design Specification Constraint				

****** Simulated with a maximum tension of 3000 lbs. ******

Std. Item:	W20B
Item ID:	9316037
CU:	C33ALSTBR

PHYSICAL PROPERTIES	
R.B.S.	6,150 lbs.
C.S.A.	0.2644 sq. in.
R. (@ 25˚C)	0.0527 Ω / 1000’
R. (@ 75˚C)	0.0629 Ω / 1000’
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.666”
WEIGHT	315 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.555 Lb/Ft
VERTICAL	1.040 Lb/Ft
TOTAL	1.479 Lb/Ft
SWING	46.55˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
514	NORMAL	725
578	EMERGENCY	766

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	1444	827	483	333	1220	707	467	353	998	622	457	367	821	568	450	378
ACTUAL SPAN (FEET)																
50	1	1	2	4	1	2	3	3	1	2	3	3	1	2	3	3
60	1	2	4	5	1	2	4	5	2	3	4	5	2	3	4	5
70	2	3	5	7	2	3	5	7	2	4	5	6	3	4	5	6
80	2	4	6	9	2	4	6	9	3	5	7	8	4	5	7	8
90	3	5	8	12	3	5	8	11	4	6	8	10	5	7	9	10
100	3	6	10	14	4	7	10	13	5	8	10	13	6	8	11	13
110	4	7	12	17	5	8	12	16	6	9	13	16	7	10	13	15
120	5	8	14	20	6	10	15	19	7	11	15	19	8	12	15	18
130	6	10	16	24	7	11	17	23	8	13	17	22	10	14	18	21
140	6	11	19	28	8	13	20	26	9	15	20	25	11	16	21	25
150	7	13	22	32	9	15	23	30	11	17	23	29	13	19	24	28
160	8	15	25	36	10	17	26	34	12	20	26	33	15	21	27	32
170	10	17	28	41	11	20	29	39	14	22	30	37	17	24	30	36
180	11	19	32	46	13	22	33	44	15	25	34	42	19	27	34	41
190	12	21	35	51	14	24	37	49	17	28	37	47	21	30	38	45
200	13	23	39	57	16	27	41	54	19	31	41	52	23	33	42	50
210	15	26	43	63	17	30	45	59	21	34	46	57	25	37	46	55
220	16	28	47	69	19	33	49	65	23	37	50	62	28	41	51	61
230	17	31	52	75	21	36	54	71	25	40	55	68	30	44	56	66
240	19	33	56	82	22	39	58	77	27	44	60	74	33	48	60	72
250	21	36	61	89	24	42	63	84	30	48	65	81	36	52	66	78
260	22	39	66	96	26	46	69	91	32	52	70	87	39	57	71	85
270	24	42	71	104	28	49	74	98	35	56	75	94	42	61	77	91
280	26	46	76	111	31	53	79	105	37	60	81	101	45	66	82	98
290	28	49	82	119	33	57	85	113	40	64	87	108	48	70	88	105
300	30	52	88	128	35	61	91	121	43	69	93	116	52	75	95	113

Supersedes 7/15 Issue – Updated RBS, loading properties, sags, and tensions.

Std. Item:	W20B
Item ID:	9316037
CU:	C33ALSTBR

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	0.72	1.80	2.04	5.40	8.76	11.16	13.80	14.88
75	1.68	3.72	4.06	8.76	13.44	17.04	20.88	22.44
100	3.12	6.36	6.79	12.84	18.60	23.28	28.20	30.24
125	5.88	11.64	12.14	19.20	25.68	31.08	36.96	39.36
150	10.56	18.72	19.27	27.00	33.96	39.96	46.56	49.44
175	18.00	27.60	28.17	36.12	43.56	50.04	57.24	60.48
200	27.84	37.92	38.51	46.80	54.48	61.32	69.12	72.60
225	39.60	49.80	50.39	58.68	66.60	73.80	82.20	85.80
250	52.92	63.00	63.60	72.00	80.16	87.60	96.36	100.20
275	67.68	77.64	78.25	86.76	95.04	102.72	111.84	115.92
300	83.88	93.72	94.33	102.84	111.24	119.16	128.52	132.84

Supersedes 7/15 Issue – Updated sags and tensions.

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	3.24	4.32	5.76	1710
75	6.72	8.16	9.48	1862
100	11.04	12.84	13.92	*2000
125	17.40	19.44	20.52	*2000
150	24.96	27.36	28.44	*2000
175	34.08	36.72	37.68	*1997
200	44.52	47.40	48.36	*1994
225	56.40	59.52	60.36	*1993
250	69.72	72.84	73.80	*1992
275	84.48	87.72	88.44	*1992
300	100.56	103.80	104.64	*1993
** Note: Design Specification Constraint*				

Std. Item:	W21C
Item ID:	9305136
CU:	

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	6,150 lbs.	TRANSVERSE	0.646 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.2644 sq. in.	VERTICAL	1.390 Lb/Ft			
R. (@ 25˚C)	0.0527 Ω / 1000’	TOTAL	1.833 Lb/Ft	425	NORMAL	593
R. (@ 75˚C)	0.0629 Ω / 1000’			519	EMERGENCY	657
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	43.31˚			
CONDUCTOR DIAMETER	0.607”					
COMPLETE DIAMETER	0.937” (Nominal)					
WEIGHT	497 lbs / 1000’					

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	1215	938	713	510	1231	958	739	545	1244	977	764	577	1256	994	787	608
ACTUAL SPAN (FEET)																
50	1	2	3	4	2	3	3	4	2	3	3	4	2	3	3	4
60	2	3	5	6	3	4	5	6	3	4	5	6	4	4	5	5
70	3	5	7	8	4	5	7	8	4	6	7	8	5	6	7	7
80	4	6	9	11	5	7	9	10	6	7	9	10	6	8	9	10
90	5	8	11	14	6	9	11	13	7	9	11	13	8	10	11	12
100	6	10	13	17	7	11	13	16	9	11	13	16	10	12	14	15
110	7	12	16	20	9	13	16	19	10	14	16	19	12	14	16	18
120	9	14	19	24	11	15	19	23	12	16	19	22	14	17	19	22
130	10	16	22	29	12	18	23	27	15	19	23	26	16	20	23	26
140	12	19	26	33	14	21	26	32	17	22	26	30	19	23	27	30
150	13	22	30	38	17	24	30	36	19	25	30	35	22	27	30	34
160	15	25	34	43	19	27	34	41	22	29	35	40	25	30	35	39
170	17	28	38	49	21	31	39	47	25	33	39	45	28	34	39	44
180	19	31	43	55	24	34	43	52	28	37	44	50	32	38	44	49
190	22	35	48	61	27	38	48	58	31	41	49	56	35	43	49	55
200	24	38	53	68	29	42	54	64	35	45	54	62	39	47	54	61
210	26	42	59	75	32	47	59	71	38	50	59	69	43	52	60	67
220	29	46	64	82	36	51	65	78	42	55	65	75	47	57	65	73
230	32	51	70	89	39	56	71	85	46	60	71	82	52	63	72	80
240	35	55	77	97	42	61	77	93	50	65	78	90	56	68	78	87
250	37	60	83	106	46	66	84	101	54	71	84	97	61	74	85	95
260	40	65	90	114	50	71	90	109	59	77	91	105	66	80	91	103
270	44	70	97	123	54	77	98	117	63	83	98	113	71	86	99	111
280	47	75	104	132	58	83	105	126	68	89	106	122	76	93	106	119
290	50	81	112	142	62	89	113	135	73	95	113	131	82	100	114	128
300	54	86	120	152	66	95	120	145	78	102	121	140	88	107	122	137

Supersedes 7/17 Issue – Corrected Sag Table.

Std. Item:	W21C
Item ID:	9305136
CU:	

Supersedes 7/17 Issue – Updated Sag Table

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.20	2.76	5.88	9.00	11.40	13.92	15.00	15.96
75	2.76	5.64	9.96	14.04	17.52	21.24	22.80	24.24
100	6.12	11.40	16.68	21.48	25.56	30.12	32.04	33.96
125	12.24	19.20	24.96	30.24	34.92	40.20	42.48	44.64
150	21.00	28.80	34.80	40.56	45.72	51.60	54.12	56.64
175	32.04	40.08	46.32	52.44	57.84	64.32	67.08	69.84
200	45.00	53.16	59.52	65.76	71.64	78.36	81.48	84.36
225	59.76	67.80	74.40	80.88	86.88	94.08	97.32	100.44
250	76.20	84.24	90.84	97.56	103.80	111.24	114.60	117.96
275	94.32	102.36	109.08	115.80	122.28	129.96	133.56	136.92
300	114.12	122.28	129.00	135.84	142.44	150.36	154.08	157.56

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	3.84	5.16	6.36	1771
75	7.92	9.6	10.68	1955
100	14.28	16.44	17.52	1932
125	22.32	24.96	26.04	1927
150	32.04	34.92	36	1930
175	43.56	46.68	47.64	1936
200	56.64	59.88	60.84	1943
225	71.4	74.88	75.72	1950
250	87.96	91.44	92.28	1956
275	106.2	109.8	110.52	1961
300	126.12	129.72	130.56	1965
** Note: Design Specification Constraint*				

Std. Item:	W20A
Item ID:	9314544
CU:	C10AAACBR

PHYSICAL PROPERTIES	
R.B.S.	4,280 lbs.
C.S.A.	0.0968 sq. in.
R. (@ 25˚C)	0.166 Ω / 1000’
R. (@ 75˚C)	0.195 Ω / 1000’
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.398”
WEIGHT	115 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.466 Lb/Ft
VERTICAL	0.673 Lb/Ft
TOTAL	1.119 Lb/Ft
SWING	59.98˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
256	NORMAL	354
286	EMERGENCY	374

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	1164	878	638	408	1173	887	650	425	1181	897	662	442	1190	907	675	459
ACTUAL SPAN (FEET)																
50	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
60	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1
70	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2
80	1	1	2	3	1	1	2	3	1	1	2	3	1	1	2	2
90	1	2	2	3	1	2	2	3	1	2	2	3	1	2	2	3
100	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
110	2	2	3	5	2	2	3	5	2	2	3	5	2	2	3	5
120	2	3	4	6	2	3	4	6	2	3	4	6	2	3	4	5
130	2	3	5	7	3	3	5	7	2	3	4	7	2	3	4	6
140	3	4	5	8	3	4	5	8	3	4	5	8	3	4	5	7
150	3	4	6	10	3	4	6	9	3	4	6	9	3	4	6	8
160	4	5	7	11	4	5	7	10	4	5	7	10	4	5	7	10
170	4	6	8	12	4	6	8	12	4	6	8	11	4	6	7	11
180	5	6	9	14	5	6	9	13	5	6	9	13	5	6	8	12
190	5	7	10	15	5	7	10	15	5	7	9	14	5	7	9	14
200	6	8	11	17	6	8	11	16	6	8	11	16	6	8	10	15
210	6	9	12	19	7	9	12	18	6	9	12	17	6	8	11	17
220	7	10	13	20	7	10	13	20	7	9	13	19	7	9	12	18
230	8	10	14	22	8	10	14	21	8	10	14	21	8	10	13	20
240	8	11	15	24	9	11	15	23	8	11	15	23	8	11	15	22
250	9	12	17	26	9	12	17	25	9	12	16	24	9	12	16	23
260	10	13	18	29	10	13	18	27	10	13	18	26	10	13	17	25
270	11	14	20	31	11	14	19	30	11	14	19	29	10	14	19	27
280	11	15	21	33	12	15	21	32	11	15	21	31	11	15	20	29
290	12	17	23	36	13	17	22	34	12	16	22	33	12	16	21	32
300	13	18	24	38	13	18	24	36	13	17	24	35	13	17	23	34

Supersedes 7/15 Issue – Updated RBS, load properties, sags, and tensions.

Std. Item:	W20A
Item ID:	9314544
CU:	C10AAACBR

Supersedes 7/15 Issue – Updated sags and tensions.

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	0.36	0.60	0.63	1.08	3.36	7.32	10.80	12.12
75	0.96	1.32	1.39	2.40	6.12	11.40	16.32	18.36
100	1.56	2.40	2.52	4.20	9.24	15.72	22.08	24.72
125	2.52	3.60	3.78	6.36	12.60	20.16	27.96	31.08
150	3.60	5.28	5.52	8.88	16.32	24.96	33.96	37.68
175	4.92	7.08	7.39	11.76	20.28	29.88	40.20	44.40
200	6.48	9.24	9.62	14.88	24.60	35.04	46.44	51.24
225	8.16	11.64	12.08	18.24	28.92	40.32	52.92	58.20
250	10.08	14.28	14.79	21.96	33.60	45.84	59.52	65.28
275	12.24	17.16	17.74	25.92	38.40	51.48	66.12	72.36
300	15.48	21.96	22.67	32.64	46.44	60.12	75.48	81.96

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	3.60	3.24	2.04	1155
75	7.68	6.72	4.32	1237
100	12.60	11.16	7.32	1328
125	18.48	16.20	10.68	1421
150	24.96	21.84	14.52	1514
175	32.04	27.84	18.72	1605
200	39.60	34.44	23.16	1696
225	47.64	41.28	27.96	1784
250	56.16	48.60	33.12	1870
275	65.04	56.28	38.40	1954
300	75.60	65.76	46.32	*2000

** Note: Design Specification Constraint*

Std. Item:	W21NA
Item ID:	9313250[E]
CU:	C1/0ALPESCNE
CU:	C10ALSCHMPNE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	4,280 lbs.	**TRANSVERSE**	0.676 Lb/Ft	**SUMMER (37.7˚C)**	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
C.S.A.	0.0968 sq. in.	**VERTICAL**	1.374 Lb/Ft			
R. (@ 25˚C)	0.166 Ω / 1000’	**TOTAL**	1.831 Lb/Ft	200	**NORMAL**	280
R. (@ 75˚C)	0.195 Ω / 1000’			244	**EMERGENCY**	310
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	**SWING**	50.48˚			
CONDUCTOR DIAMETER	0.398”					
COMPLETE DIAMETER	1.028” (Nominal)					
WEIGHT	424 lbs / 1000’					

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				**150**				**175**				**200**			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	1259	998	794	617	1273	1022	828	661	1281	1042	858	701	1168	956	801	672
ACTUAL SPAN (FEET)																
50	1	2	2	3	1	2	2	2	1	2	2	2	1	2	2	2
60	2	2	3	4	2	2	3	3	2	2	3	3	2	2	3	3
70	2	3	4	5	2	3	4	5	2	3	4	4	3	3	4	5
80	3	4	5	7	3	4	5	6	3	4	5	6	3	4	5	6
90	4	5	6	8	4	5	6	8	4	5	6	7	4	5	6	8
100	5	6	8	10	5	6	8	10	5	6	7	9	5	7	8	9
110	6	8	10	12	6	8	9	12	6	7	9	11	7	8	10	11
120	7	9	12	15	7	9	11	14	7	9	11	13	8	10	11	14
130	9	11	13	17	8	11	13	16	8	10	13	15	9	11	13	16
140	10	13	16	20	10	12	15	19	10	12	15	18	11	13	16	19
150	11	14	18	23	11	14	17	22	11	14	17	20	12	15	18	21
160	13	16	20	26	13	16	20	25	13	16	19	23	14	17	20	24
170	15	19	23	30	14	18	22	28	14	18	21	26	16	19	23	27
180	16	21	26	33	16	20	25	31	16	20	24	29	18	22	26	31
190	18	23	29	37	18	23	28	35	18	22	27	33	20	24	29	34
200	20	26	32	41	20	25	31	38	20	25	30	36	22	27	32	38
210	22	28	35	45	22	28	34	42	22	27	33	40	24	29	35	42
220	25	31	39	50	24	30	37	46	24	30	36	44	26	32	38	46
230	27	34	42	54	27	33	41	51	26	32	39	48	29	35	42	50
240	29	37	46	59	29	36	44	55	29	35	43	52	31	38	46	55
250	32	40	50	64	31	39	48	60	31	38	46	57	34	42	50	59
260	34	43	54	70	34	42	52	65	34	41	50	61	37	45	54	64
270	37	47	58	75	37	45	56	70	36	45	54	66	40	49	58	69
280	40	50	63	81	39	49	60	75	39	48	58	71	43	52	62	74
290	43	54	67	87	42	52	65	81	42	52	62	76	46	56	67	80
300	46	58	72	93	45	56	69	86	45	55	67	82	49	60	72	85

Supersedes 7/15 Issue – Updated RBS, loading properties, sags, and tensions.

Std. Item:	W21NA
Item ID:	9313250[E]
CU:	C1/0ALPESCNE
CU:	C10ALSCHMPNE

Supersedes 7/15 Issue – Updated sags and tensions.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.44	2.16	2.25	3.48	5.88	8.64	11.52	12.72
75	3.36	4.68	4.84	7.08	10.56	14.04	18.12	19.80
100	6.00	8.16	8.38	11.52	15.84	20.16	25.08	27.24
125	9.24	12.36	12.65	16.68	21.72	26.76	32.64	35.16
150	13.32	17.40	17.74	22.56	28.32	33.96	40.68	43.56
175	18.24	23.16	23.56	29.16	35.52	41.76	49.20	52.44
200	26.04	32.40	32.86	39.24	46.20	52.92	60.84	64.32
225	37.68	45.12	45.62	52.68	60.00	66.96	75.12	78.84
250	52.32	60.36	60.88	68.16	75.72	82.80	91.32	95.16
275	69.48	77.76	78.30	85.80	93.36	100.56	109.32	113.16
300	89.16	97.56	98.09	105.48	113.16	120.48	129.24	133.32

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	5.52	5.64	4.80	1252
75	11.04	11.16	9.24	1395
100	17.88	17.76	14.64	1536
125	25.68	25.20	20.76	1672
150	34.44	33.36	27.60	1800
175	43.92	42.36	35.16	1921
200	55.80	54.00	45.72	1972
225	70.20	68.16	59.40	1986
250	86.40	84.12	74.88	1995
275	104.28	102.00	92.52	*2000
300	124.20	121.80	112.20	*2000
** Note: Design Specification Constraint*				

Std. Item:	W20CA
Item ID:	9302832
CU:	C1/0ALHMPESTNE
CU:	C10ALSCPE1NE

PHYSICAL PROPERTIES	
R.B.S.	4,280 lbs.
C.S.A.	0.0968 sq. in.
R. (@ 25˚C)	0.166 Ω / 1000’
R. (@ 75˚C)	0.195 Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.398”
COMPLETE DIAMETER	0.728” (Nominal)
WEIGHT	255 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.576 Lb/Ft
VERTICAL	1.019 Lb/Ft
TOTAL	1.470 Lb/Ft
SWING	54.99˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
214	**NORMAL**	296
259	**EMERGENCY**	327

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				**150**				**175**				**200**			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	1215	938	713	510	1231	958	739	545	1244	977	764	577	1256	994	787	608
ACTUAL SPAN (FEET)																
50	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2
60	1	1	2	3	1	1	2	3	1	1	2	2	1	1	2	2
70	2	2	3	4	2	2	3	3	1	2	2	3	1	2	2	3
80	2	3	3	5	2	3	3	5	2	3	3	4	2	2	3	4
90	3	3	4	6	3	3	4	6	2	3	4	5	2	3	4	5
100	3	4	5	8	3	4	5	7	3	4	5	7	3	4	5	6
110	4	5	7	9	4	5	6	9	4	5	6	8	4	5	6	8
120	5	6	8	11	4	6	7	10	4	6	7	10	4	6	7	9
130	5	7	9	13	5	7	9	12	5	7	8	11	5	7	8	11
140	6	8	11	15	6	8	10	14	6	8	10	13	6	8	10	12
150	7	9	12	17	7	9	12	16	7	9	11	15	7	9	11	14
160	8	10	14	19	8	10	13	18	8	10	13	17	8	10	12	16
170	9	12	16	22	9	12	15	20	9	11	14	19	9	11	14	18
180	10	13	17	24	10	13	17	23	10	13	16	21	10	12	16	20
190	11	15	19	27	11	15	19	25	11	14	18	24	11	14	18	23
200	13	16	22	30	12	16	21	28	12	16	20	26	12	15	19	25
210	14	18	24	33	14	18	23	31	13	17	22	29	13	17	21	28
220	15	20	26	36	15	19	25	34	15	19	24	32	15	19	24	30
230	17	22	28	40	16	21	27	37	16	21	27	35	16	20	26	33
240	18	24	31	43	18	23	30	41	18	23	29	38	18	22	28	36
250	20	26	34	47	19	25	32	44	19	24	31	41	19	24	30	39
260	21	28	36	51	21	27	35	48	21	26	34	45	21	26	33	43
270	23	30	39	55	23	29	38	51	22	29	37	48	22	28	35	46
280	25	32	42	59	24	32	41	55	24	31	39	52	24	30	38	49
290	26	34	45	63	26	34	44	59	26	33	42	56	26	32	41	53
300	28	37	48	68	28	36	47	63	28	35	45	60	28	35	44	57

Supersedes 7/15 Issue – Updated RBS, loading properties, sags and tensions.

Std. Item:	W20CA
Item ID:	9302830
CU:	C1/0ALHMPESTNE
CU:	C10ALSCPE1NE

Supersedes 7/15 Issue – Updated sags and tensions.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	0.84	1.32	1.38	2.28	4.80	7.92	11.16	12.36
75	2.04	2.88	3.01	4.80	8.52	12.72	17.16	18.96
100	3.60	5.04	5.24	8.04	12.84	17.88	23.52	25.80
125	5.64	7.80	8.07	11.88	17.52	23.40	30.12	32.88
150	8.04	11.16	11.49	16.08	22.68	29.40	37.08	40.32
175	10.92	14.88	15.28	20.88	28.32	35.64	44.28	48.00
200	14.28	19.20	19.66	26.16	34.20	42.36	51.84	55.92
225	18.24	24.12	24.64	31.92	40.80	49.56	59.76	64.32
250	25.80	33.72	34.34	42.96	52.56	61.68	72.24	77.04
275	36.96	46.68	47.36	56.88	66.72	75.96	86.88	91.68
300	51.00	61.92	62.62	72.48	82.44	91.80	102.84	107.88

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	4.56	4.56	3.60	1202
75	9.48	9.12	7.08	1317
100	15.36	14.64	11.40	1436
125	22.20	21.00	16.32	1553
150	29.76	27.96	21.72	1668
175	38.04	35.52	27.72	1778
200	46.92	43.68	34.08	1885
225	56.40	52.32	41.04	1984
250	69.00	64.56	52.44	*2000
275	83.64	78.84	66.36	*2000
300	99.48	94.44	81.72	*2000
** Note: Design Specification Constraint*				

Non-Standard Overhead Distribution Conductors

Maintenance Only

Std. Item:	
Item ID:	9302815[E]
CU:	

Supersedes 1/07 Issue – Added item ID.

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	11400 lbs.	TRANSVERSE	0.6387 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.4995 sq. in.	VERTICAL	1.479 Lb/Ft			
R. (@ 25˚C)	0.0282 Ω / 1000'	TOTAL	1.911 Lb/Ft	766	NORMAL	1095
R. (@ 75˚C)	0.0335 Ω / 1000'			866	EMERGENCY	1159
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	37.55˚			
CONDUCTOR DIAMETER	0.918"					
WEIGHT	597 lbs / 1000'					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.32	4.44	7.80	10.56	12.72	15.12	16.08	17.04
75	4.08	9.48	13.68	17.28	20.28	23.64	25.08	26.40
100	9.48	16.20	21.00	25.32	29.04	33.12	34.92	36.72
125	17.52	24.60	29.76	34.68	38.88	43.80	45.96	48.00
150	27.36	34.68	40.20	45.48	50.28	55.68	58.20	60.48
175	39.12	46.56	52.32	57.84	63.00	69.00	71.64	74.28
200	52.68	60.12	66.00	71.88	77.40	83.76	86.64	89.52
225	67.92	75.48	81.60	87.60	93.36	100.08	103.20	106.20
250	85.08	92.64	98.76	105.00	111.00	118.08	121.32	124.44
275	103.92	111.48	117.84	124.20	130.32	137.64	141.00	144.36
300	124.68	132.24	138.60	145.08	151.32	158.88	162.36	165.84

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	3.60	5.88	8.04	*1994
75	8.28	11.40	13.92	*1947
100	14.76	18.60	21.24	*1936
125	23.16	27.36	30.12	*1939
150	33.12	37.68	40.68	*1945
175	45.00	49.68	52.80	*1953
200	58.56	63.48	66.60	*1959
225	73.92	78.96	82.08	*1965
250	91.08	96.24	99.36	*1970
275	110.04	115.20	118.44	*1974
300	130.68	135.96	139.20	*1977

** Note: Design Specification Constraint*

636.0 KCMIL, 37 STRAND, BARE AAC, "ORCHID"
MAINTENANCE ONLY

Std. Item:	
Item ID:	9302815[E]
CU:	C636ALSTPENE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	11,400 lbs.	TRANSVERSE	0.7022 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.5278 sq. in.	VERTICAL	1.745 Lb/Ft			
R. (@ 25˚C)	0.0282 Ω / 1000’	TOTAL	2.181 Lb/Ft	627	NORMAL	985
R. (@ 75˚C)	0.0335 Ω / 1000’			777	EMERGENCY	1072
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	36.64˚			
CONDUCTOR DIAMETER	0.918”					
COMPLETE DIAMETER	1.108”					
WEIGHT	745 lbs / 1000’					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.92	5.40	8.52	11.04	13.08	15.36	16.32	17.28
75	5.76	11.04	14.88	18.24	21.12	24.36	25.68	27.00
100	12.72	18.72	23.04	27.00	30.48	34.44	36.24	37.92
125	21.96	28.20	32.88	37.32	41.40	45.96	48.00	49.92
150	33.24	39.72	44.64	49.44	53.88	59.04	61.32	63.48
175	46.68	53.16	58.32	63.36	68.16	73.68	76.20	78.72
200	62.16	68.64	73.92	79.20	84.24	90.24	92.88	95.52
225	79.56	86.16	91.56	97.08	102.24	108.48	111.36	114.12
250	99.12	105.72	111.24	116.76	122.16	128.64	131.64	134.52
275	120.60	127.32	132.84	138.60	144.12	150.84	153.84	156.96
300	144.24	150.96	156.60	162.36	168.00	174.84	178.08	181.20

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	4.20	6.60	8.64	*1955
75	9.60	12.72	15.12	*1924
100	17.04	20.76	23.28	*1924
125	26.40	30.48	33.24	*1934
150	37.92	42.24	45.00	*1944
175	51.36	55.92	58.68	*1953
200	66.84	71.52	74.40	*1961
225	84.36	89.16	92.04	*1967
250	103.92	108.72	111.72	*1972
275	125.52	130.44	133.44	*1976
300	149.16	154.08	157.08	*1979
** Note: Design Specification Constraint*				

Supersedes 1/07 Issue – Updated item ID.

636.0 KCMIL, 37 STRAND, AAC, 95 MIL HDPE COVERING, “TANGERINE”

MAINTENANCE ONLY

PHYSICAL PROPERTIES		LOADING PROPERTIES	
R.B.S.	5535 lbs.	TRANSVERSE	0.6693 Lb/Ft
C.S.A.	0.3552 sq. in.	VERTICAL	1.450 Lb/Ft
R. (@ 25˚C)	0.0528 Ω / 1000'	TOTAL	1.897 Lb/Ft
R. (@ 75˚C)	0.0630 Ω / 1000'		
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	44.44˚
CONDUCTOR DIAMETER	0.666"		
COMPLETE DIAMETER	1.006"		
WEIGHT	513 lbs / 1000'		

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
396	NORMAL	626
490	EMERGENCY	680

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.44	4.20	7.56	10.32	12.48	14.88	15.84	16.80
75	3.12	7.56	12.00	15.96	19.08	22.56	24.12	25.44
100	6.96	13.44	18.60	23.28	27.24	31.56	33.48	35.28
125	13.92	21.48	27.00	32.16	36.72	41.88	44.04	46.20
150	23.76	31.44	37.32	42.84	47.88	53.52	56.04	58.44
175	35.40	43.32	49.32	55.20	60.48	66.72	69.48	72.12
200	48.96	56.76	63.00	69.00	74.64	81.24	84.24	87.12
225	64.20	72.12	78.36	84.60	90.48	97.44	100.56	103.68
250	81.24	89.04	95.52	101.88	108.00	115.20	118.56	121.68
275	100.08	107.88	114.36	120.84	127.08	134.64	138.00	141.36
300	120.60	128.52	135.00	141.60	147.96	155.76	159.24	162.72

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.08	6.00	7.80	1733
75	8.16	10.56	12.48	1969
100	14.28	17.28	19.32	*2000
125	22.32	25.68	27.84	*1995
150	32.28	36.12	38.16	*1981
175	44.16	48.12	50.28	*1976
200	57.60	61.80	63.96	*1976
225	72.96	77.28	79.44	*1977
250	90.00	94.32	96.60	*1978
275	108.84	113.28	115.44	*1980
300	129.36	133.92	136.08	*1982
** Note: Design Specification Constraint*				

Supersedes 7/10 Issue – Deleted obsolete item ID.

336.4 KCMIL, 19 STRAND, AAC, 170 MIL HDPE COVERING, "ANONA"
MAINTENANCE ONLY

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	5790 lbs.	TRANSVERSE	0.6084 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.2845 sq. in.	VERTICAL	1.242 Lb/Ft			
R. (@ 25˚C)	0.0528 Ω / 1000’	TOTAL	1.683 Lb/Ft	432	NORMAL	665
R. (@ 75˚C)	0.0630 Ω / 1000’			530	EMERGENCY	723
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	44.72˚			
CONDUCTOR DIAMETER	0.666”					
COMPLETE DIAMETER	0.826”					
WEIGHT	417 lbs / 1000’					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.08	2.88	6.36	9.36	11.76	14.28	15.24	16.32
75	2.40	5.64	10.32	14.52	18.00	21.60	23.16	24.60
100	4.68	9.72	15.36	20.52	24.84	29.52	31.56	33.48
125	9.36	16.80	23.04	28.80	33.72	39.12	41.52	43.80
150	16.92	25.56	32.16	38.28	43.68	49.80	52.56	55.08
175	27.00	35.88	42.72	49.20	55.08	61.80	64.68	67.56
200	38.88	47.88	54.84	61.68	67.80	75.00	78.12	81.24
225	52.32	61.32	68.52	75.48	81.96	89.52	92.88	96.24
250	67.44	76.44	83.64	90.84	97.56	105.48	109.08	112.44
275	84.12	93.12	100.44	107.76	114.60	122.88	126.60	130.20
300	102.36	111.36	118.68	126.12	133.20	141.72	145.56	149.28

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	3.72	5.16	6.72	1688
75	7.56	9.48	10.92	1876
100	12.60	14.88	16.32	*1995
125	19.92	22.68	24.12	*1975
150	28.92	31.92	33.24	*1967
175	39.36	42.60	44.04	*1965
200	51.36	54.84	56.16	*1966
225	64.92	68.52	69.84	*1969
250	80.16	83.76	85.08	*1971
275	96.84	100.56	101.88	*1974
300	115.08	118.92	120.24	*1977
** Note: Design Specification Constraint*				

Std. Item:	
Item ID:	9315425
CU:	C33ALSTPER/T

Supersedes 7/10 Issue – Updated item ID.

PHYSICAL PROPERTIES	
R.B.S.	5535 lbs.
C.S.A.	0.2757 sq. in.
R. (@ 25˚C)	0.0528 Ω / 1000'
R. (@ 75˚C)	0.0630 Ω / 1000'
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.666"
COMPLETE DIAMETER	0.786"
WEIGHT	394 lbs / 1000'

LOADING PROPERTIES	
TRANSVERSE	0.5949 Lb/Ft
VERTICAL	1.194 Lb/Ft
TOTAL	1.634 Lb/Ft
SWING	44.93˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
441	NORMAL	675
541	EMERGENCY	735

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.08	2.88	6.48	9.48	11.76	14.28	15.36	16.32
75	2.40	5.64	10.32	14.64	18.00	21.60	23.16	24.60
100	4.32	9.00	14.76	20.04	24.48	29.16	31.20	33.12
125	8.40	15.60	22.08	27.96	33.00	38.52	40.92	43.20
150	15.36	24.12	30.84	37.20	42.72	48.96	51.72	54.36
175	24.84	34.08	41.16	47.88	53.88	60.60	63.60	66.48
200	36.36	45.72	52.92	59.88	66.24	73.56	76.80	79.92
225	49.44	58.80	66.12	73.32	79.92	87.72	91.20	94.44
250	64.08	73.44	80.88	88.20	95.16	103.20	106.92	110.40
275	80.28	89.64	97.08	104.64	111.72	120.12	123.96	127.56
300	98.04	107.28	114.84	122.52	129.72	138.48	142.32	146.16

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	3.72	5.28	6.72	1622
75	7.68	9.48	11.04	1807
100	12.36	14.40	15.72	1990
125	19.32	21.96	23.16	*1978
150	27.96	30.84	32.16	*1970
175	38.16	41.28	42.48	*1968
200	49.80	53.16	54.36	*1969
225	63.00	66.48	67.56	*1971
250	77.76	81.24	82.44	*1973
275	93.96	97.56	98.64	*1976
300	111.72	115.44	116.40	*1978
** Note: Design Specification Constraint*				

336.4 KCMIL, 19 STRAND, AAC, 60 MIL HDPE COVERING, "ANONA"

MAINTENANCE ONLY

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	8350 lbs.	TRANSVERSE	0.5205 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1939 sq. in.	VERTICAL	0.952 Lb/Ft			
R. (@ 25˚C)	0.0822 Ω / 1000’	TOTAL	1.385 Lb/Ft	360	NORMAL	504
R. (@ 75˚C)	0.1160 Ω / 1000’			399	EMERGENCY	527
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	44.05˚			
CONDUCTOR DIAMETER	0.563”					
WEIGHT	291 lbs.					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.60	0.96	1.92	3.96	5.40	7.20	8.04	8.88
75	1.44	2.28	4.68	8.04	9.96	12.48	13.56	14.64
100	2.76	4.80	8.88	13.32	15.72	18.60	20.04	21.24
125	4.92	8.76	14.52	19.80	22.56	25.92	27.48	28.92
150	8.64	14.76	21.48	27.36	30.48	34.20	35.88	37.56
175	14.40	22.56	29.88	36.24	39.60	43.56	45.48	47.28
200	22.68	32.04	39.48	46.32	49.80	54.12	56.16	58.08
225	33.24	42.96	50.52	57.60	61.32	65.88	67.92	69.96
250	45.48	55.20	62.88	70.20	74.04	78.84	81.00	83.16
275	59.16	68.76	76.44	84.00	87.96	92.88	95.16	97.44
300	74.16	83.64	91.44	99.00	103.20	108.24	110.64	112.92

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	2.64	2.76	2.52	*2000
75	5.88	6.24	5.76	*2000
100	10.44	10.92	10.20	*2000
125	16.20	16.92	16.08	*2000
150	23.40	24.24	23.16	*2000
175	31.80	32.76	31.56	*2000
200	41.52	42.60	41.28	*2000
225	52.68	53.64	52.32	*2000
250	65.04	66.12	64.68	*2000
275	78.60	79.80	78.36	*2000
300	93.60	94.80	93.24	*2000
** Note: Design Specification Constraint*				

Supersedes 1/07 Issue - Corrected unloaded sags for 200’ and 225’ spans.

Supersedes 1/07 Issue – Corrected unloaded sags for 200' and 225' spans.

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	8560 lbs.	TRANSVERSE	0.5213 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1939 sq. in.	VERTICAL	0.893 Lb/Ft			
R. (@ 25˚C)	0.0831 Ω / 1000'	TOTAL	1.334 Lb/Ft	396	NORMAL	555
R. (@ 75˚C)	0.0973 Ω / 1000'			445	EMERGENCY	587
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	50.53˚			
CONDUCTOR DIAMETER	0.563"					
WEIGHT	232 lbs.					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.48	0.72	1.44	4.80	8.28	11.52	12.72	13.92
75	1.08	1.80	3.72	8.76	13.44	17.88	19.80	21.48
100	2.04	3.48	7.20	13.80	19.32	24.96	27.36	29.52
125	3.60	6.36	12.24	19.80	26.16	32.88	35.64	38.16
150	6.00	10.92	18.84	27.00	34.08	41.52	44.64	47.64
175	9.72	17.64	26.64	35.40	42.96	51.12	54.60	57.96
200	15.60	26.28	35.88	45.00	52.92	61.68	65.52	69.12
225	24.36	36.60	46.44	55.80	64.08	73.32	77.40	81.24
250	35.52	48.36	58.32	67.80	76.32	86.04	90.36	94.56
275	48.60	61.44	71.40	81.00	89.76	99.96	104.40	108.72
300	63.00	75.72	85.80	95.52	104.52	114.96	119.64	124.08

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	2.52	2.64	2.16	*2000
75	5.64	5.88	5.04	*2000
100	9.96	10.32	9.24	*2000
125	15.60	16.08	14.76	*2000
150	22.56	23.04	21.48	*2000
175	30.60	31.20	29.52	*2000
200	40.08	40.68	38.88	*2000
225	50.64	51.36	49.44	*2000
250	62.52	63.24	61.32	*2000
275	75.72	76.44	74.40	*2000
300	90.12	90.84	88.80	*2000
** Note: Design Specification Constraint*				

Std. Item:	W18B
Item ID:	9315759[Y]
CU:	C40ALSTBR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	3830 lbs.	**TRANSVERSE**	0.5073 Lb/Ft	**SUMMER (37.7˚C)**	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
C.S.A.	0.1663 sq. in.	**VERTICAL**	0.835 Lb/Ft			
R. (@ 25˚C)	0.0835 Ω / 1000’	**TOTAL**	1.277 Lb/Ft	383	**NORMAL**	535
R. (@ 75˚C)	0.0999 Ω / 1000’			429	**EMERGENCY**	565
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	**SWING**	52.73˚			
CONDUCTOR DIAMETER	0.522”					
WEIGHT	199 lbs.					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	0.72	2.04	5.64	8.88	11.40	13.92	15.00	16.08
75	1.80	4.20	9.12	13.80	17.40	21.12	22.68	24.12
100	3.12	6.96	13.08	18.84	23.40	28.32	30.48	32.40
125	4.92	10.08	17.28	24.12	29.76	35.76	38.40	40.80
150	6.96	13.56	21.72	29.64	36.24	43.32	46.32	49.20
175	9.60	17.40	26.52	35.40	42.84	51.00	54.60	57.84
200	13.32	23.04	33.00	42.48	50.76	59.76	63.72	67.44
225	21.00	33.12	43.44	53.16	61.68	71.28	75.48	79.44
250	31.68	44.88	55.32	65.16	73.92	83.88	88.32	92.52
275	44.64	57.96	68.28	78.24	87.36	97.68	102.24	106.68
300	59.16	72.36	82.68	92.76	101.88	112.56	117.36	121.92

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			**TENSION (LBS.)**
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-20**	**0**	**15**	**-20**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	4.20	5.04	6.12	1149
75	8.28	9.36	10.08	1294
100	13.32	14.28	14.52	1437
125	18.96	19.68	19.20	1575
150	25.32	25.68	24.24	1706
175	32.04	32.04	29.64	1831
200	3.33	3.31	3.05	*1915
225	4.22	4.19	3.92	*1915
250	5.21	5.18	4.90	*1915
275	6.31	6.27	5.99	*1915
300	7.51	7.47	7.18	*1915
** Note: Design Specification Constraint*				

Supersedes 7/10 Issue – Updated item ID.

Supersedes 1/07 Issue – Corrected unloaded sags for 200' and 225' spans.

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	3445 lbs.	TRANSVERSE	0.5475 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1776 sq. in.	VERTICAL	0.961 Lb/Ft			
R. (@ 25˚C)	0.0835 Ω / 1000'	TOTAL	1.406 Lb/Ft	331	NORMAL	501
R. (@ 75˚C)	0.1000 Ω / 1000'			404	EMERGENCY	545
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	51.98˚			
CONDUCTOR DIAMETER	0.522"					
COMPLETE DIAMETER	0.642"					
WEIGHT	251 lbs / 1000'					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.08	3.24	6.72	9.72	12.00	14.52	15.48	16.44
75	2.40	6.00	10.80	15.00	18.36	21.96	23.40	24.84
100	4.32	9.48	15.24	20.52	24.84	29.52	31.56	33.48
125	6.84	13.32	20.16	26.28	31.56	37.32	39.84	42.12
150	10.56	18.84	26.28	33.36	39.36	46.08	48.96	51.60
175	18.48	28.32	36.24	43.56	49.92	57.24	60.36	63.36
200	29.40	39.72	47.64	55.20	61.92	69.60	73.08	76.32
225	42.36	52.56	60.60	68.28	75.36	83.52	87.12	90.60
250	57.00	67.08	75.12	82.92	90.24	98.64	102.48	106.08
275	73.20	83.16	91.20	99.12	106.56	115.32	119.28	123.12
300	90.96	100.80	108.72	116.76	124.32	133.32	137.40	141.36

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.68	6.00	7.20	1118
75	9.24	10.56	11.64	1289
100	14.52	15.96	16.56	1450
125	20.64	21.84	21.84	1600
150	27.84	29.04	28.44	*1703
175	37.80	39.12	38.40	*1707
200	49.32	50.64	49.92	*1711
225	62.40	63.84	63.00	*1713
250	76.92	78.36	77.52	*1715
275	93.00	94.56	93.60	*1716
300	110.64	112.20	111.24	*1717

** Note: Design Specification Constraint*

4/0, 7 STRAND, AAC, 60 MIL PE COVERING, "OLIVE"

MAINTENANCE ONLY

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	8560 lbs.	TRANSVERSE	0.5604 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1939 sq. in.	VERTICAL	1.043 Lb/Ft			
R. (@ 25˚C)	0.0831 Ω / 1000'	TOTAL	1.484 Lb/Ft	337	NORMAL	512
R. (@ 75˚C)	0.0973 Ω / 1000'			412	EMERGENCY	557
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	48.05˚			
CONDUCTOR DIAMETER	0.563"					
COMPLETE DIAMETER	0.683"					
WEIGHT	307 lbs / 1000'					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.60	0.96	1.92	5.28	8.52	11.64	12.96	14.04
75	1.44	2.40	4.80	9.60	13.92	18.24	20.04	21.72
100	2.88	4.92	9.12	15.12	20.28	25.68	27.96	30.00
125	5.04	8.88	15.00	21.84	27.72	34.08	36.72	39.12
150	8.64	15.00	22.44	29.88	36.24	43.32	46.32	49.20
175	14.40	23.16	31.32	39.12	46.08	53.76	57.00	60.24
200	22.92	33.24	41.76	49.80	57.00	65.28	68.88	72.24
225	33.84	44.76	53.52	61.80	69.36	78.00	81.84	85.44
250	46.80	57.96	66.60	75.12	82.92	92.04	96.00	99.84
275	61.44	72.48	81.24	89.88	97.92	107.28	111.48	115.44
300	77.52	88.44	97.20	105.96	114.12	123.84	128.16	132.36

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	2.76	3.00	2.76	*1999
75	6.24	6.72	6.12	*2000
100	11.16	11.76	10.92	*2000
125	17.40	18.24	17.16	*2000
150	25.08	26.04	24.84	*2000
175	34.08	35.28	33.84	*2000
200	44.52	45.84	44.28	*2000
225	56.40	57.72	56.04	*2000
250	69.60	71.04	69.36	*2000
275	84.24	85.68	83.88	*2000
300	100.32	101.76	99.96	*2000

** Note: Design Specification Constraint*

Supersedes 7/10 Issue - Corrected description in title block to " AAAC. 225' spans.

4/0, 7 STRAND, AAAC, 60 MIL PE COVERING, "PLANETREE"

MAINTENANCE ONLY

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	3620 lbs.	**TRANSVERSE**	0.5451 Lb/Ft	**SUMMER (37.7˚C)**	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
C.S.A.	0.1678 sq. in.	**VERTICAL**	0.952 Lb/Ft			
R. (@ 25˚C)	0.0838 Ω / 1000’	**TOTAL**	1.397 Lb/Ft	330	**NORMAL**	499
R. (@ 75˚C)	0.1000 Ω / 1000’			402	**EMERGENCY**	543
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	**SWING**	51.87˚			
CONDUCTOR DIAMETER	0.512”					
COMPLETE DIAMETER	0.632”					
WEIGHT	248 lbs / 1000’					

Supersedes 1/07 Issue – Corrected unloaded sags for 200’ and 225’ spans.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	1.08	2.52	6.00	9.12	11.52	14.04	15.12	16.08
75	2.28	5.16	9.84	14.16	17.64	21.36	22.92	24.36
100	4.08	8.40	14.04	19.44	23.88	28.80	30.84	32.76
125	6.48	12.12	18.72	25.08	30.48	36.36	38.88	41.28
150	9.24	16.20	23.76	31.08	37.32	44.28	47.16	50.04
175	13.44	22.08	30.36	38.28	45.36	53.04	56.40	59.64
200	21.96	32.40	41.04	49.32	56.64	64.80	68.52	71.88
225	33.48	44.52	53.28	61.68	69.24	77.88	81.72	85.44
250	47.16	58.20	66.96	75.48	83.28	92.28	96.24	100.08
275	62.40	73.44	82.08	90.72	98.64	108.00	112.08	116.16
300	79.32	90.12	98.76	107.40	115.44	125.04	129.36	133.56

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-20**	**0**	**15**	**-20**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	4.68	5.64	6.60	1129
75	9.12	10.20	10.80	1287
100	14.52	15.60	15.60	1439
125	20.64	21.48	20.76	1582
150	27.48	27.96	26.40	1717
175	35.40	35.76	33.48	*1810
200	46.32	46.68	44.16	*1810
225	58.68	58.92	56.40	*1810
250	72.36	72.72	70.08	*1810
275	87.60	87.96	85.32	*1810
300	104.28	104.64	101.88	*1810
** Note: Design Specification Constraint*				

Std. Item:	
Item ID:	9315758
CU:	C10ASSTBRRLR/T

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	4380 lbs.	TRANSVERSE	0.4655 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0968 sq. in.	VERTICAL	0.704 Lb/Ft			
R. (@ 25˚C)	0.1630 Ω / 1000’	TOTAL	1.144 Lb/Ft	242	NORMAL	335
R. (@ 75˚C)	0.2160 Ω / 1000’			268	EMERGENCY	351
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	53.88˚			
CONDUCTOR DIAMETER	0.398”					
WEIGHT	145 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.48	0.72	1.32	2.88	3.96	5.76	6.60	7.56
75	1.08	1.68	2.88	5.52	7.20	9.60	10.80	11.88
100	2.04	3.00	4.92	8.76	10.80	13.68	15.12	16.56
125	3.12	4.56	7.44	12.36	14.76	18.12	19.80	21.48
150	4.44	6.60	10.20	16.20	18.84	22.68	24.60	26.52
175	6.12	8.88	13.44	20.16	23.28	27.48	29.64	31.68
200	7.92	11.40	16.92	24.48	27.84	32.52	34.80	37.08
225	10.08	14.40	20.64	28.92	32.64	37.56	40.08	42.48
250	12.36	17.52	24.72	33.60	37.56	42.84	45.48	48.12
275	17.28	24.72	33.96	42.48	46.92	52.80	55.68	58.44
300	24.72	34.92	45.60	53.40	58.20	64.56	67.56	70.56

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	3.60	3.24	2.16	1197
75	7.44	6.72	4.44	1292
100	12.36	10.92	7.32	1394
125	17.88	15.84	10.68	1498
150	24.12	21.24	14.52	1601
175	30.84	27.12	18.60	1702
200	38.16	33.48	23.04	1800
225	45.84	40.20	27.84	1896
250	54.00	47.16	32.88	1989
275	64.92	57.48	42.36	*2000
300	77.28	69.36	53.88	*2000

** Note: Design Specification Constraint*

Supersedes 7/10 Issue – Updated item ID.

1/0, 6/1 STRANDING, BARE ACSR, “RAVEN”
MAINTENANCE ONLY

Std. Item:	
Item ID:	
CU:	C10ASSTLTRT

Supersedes 7/09 Issue – Corrected unloaded sags for 200' and 225' spans.

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	4160 lbs.	TRANSVERSE	0.5407 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1348 sq. in.	VERTICAL	0.921 Lb/Ft			
R. (@ 25˚C)	0.1633 Ω / 1000'	TOTAL	1.368 Lb/Ft	210	NORMAL	320
R. (@ 75˚C)	0.2160 Ω / 1000'			256	EMERGENCY	348
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	53.82˚			
CONDUCTOR DIAMETER	0.398"					
COMPLETE DIAMETER	0.6518"					
WEIGHT	226 lbs / 1000'					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.84	1.56	3.72	5.76	7.20	8.88	9.60	10.32
75	1.80	3.36	6.72	9.72	11.64	13.92	15.00	15.96
100	3.24	576.00	10.08	14.16	16.44	19.32	20.64	21.84
125	5.04	8.64	13.92	18.96	21.60	24.96	26.52	27.96
150	7.32	12.00	18.12	24.12	27.12	30.84	32.64	34.32
175	9.96	15.72	22.68	29.52	32.88	37.08	39.00	40.92
200	14.28	21.60	29.52	36.84	40.56	45.12	47.16	49.32
225	22.32	31.68	40.08	47.52	51.36	56.28	58.44	60.72
250	33.24	43.56	52.20	59.40	63.60	68.64	70.92	73.20
275	46.32	57.00	65.52	72.72	77.04	82.20	84.72	87.00
300	61.20	71.76	80.28	87.36	91.68	97.08	99.60	102.12

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.20	4.56	4.68	1229
75	8.40	8.76	8.16	1377
100	13.44	13.56	12.24	1523
125	19.32	19.08	16.80	1664
150	25.68	24.96	21.72	1800
175	32.64	31.44	27.00	1928
200	41.04	39.48	34.20	*2000
225	51.96	50.28	44.76	*2000
250	64.20	62.40	56.76	*2000
275	77.64	75.84	70.08	*2000
300	92.40	90.48	84.72	*2000
** Note: Design Specification Constraint*				

Std. Item:	
Item ID:	
CU:	C10ASSTPER/T

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	4160 lbs.	TRANSVERSE	0.5069 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1081 sq. in.	VERTICAL	0.827 Lb/Ft			
R. (@ 25˚C)	0.1633 Ω / 1000’	TOTAL	1.270 Lb/Ft	220	NORMAL	330
R. (@ 75˚C)	0.2160 Ω / 1000’			267	EMERGENCY	359
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	53.17˚			
CONDUCTOR DIAMETER	0.398”					
COMPLETE DIAMETER	0.518”					
WEIGHT	194 lbs / 1000’					

Supersedes 7/10 Issue – Deleted obsolete item ID.

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.72	1.20	2.40	4.32	5.76	7.44	8.28	9.00
75	1.56	2.52	4.68	7.92	9.72	12.00	13.08	14.16
100	2.76	4.44	7.68	11.88	14.04	16.92	18.24	19.56
125	4.32	6.84	11.04	16.32	18.84	22.08	23.64	25.20
150	6.24	9.60	14.76	21.00	23.88	27.60	29.28	31.08
175	8.52	12.84	18.84	25.92	29.16	33.24	35.16	37.20
200	11.16	16.44	23.28	31.20	34.68	39.12	41.28	43.44
225	14.16	20.40	27.96	36.60	40.32	45.24	47.64	49.92
250	20.88	29.52	38.40	46.80	50.88	56.16	58.68	61.08
275	30.48	41.04	50.52	58.56	63.00	68.52	71.16	73.68
300	42.84	54.36	64.08	71.64	76.32	82.08	84.72	87.48

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	4.08	4.08	3.36	1183
75	8.28	8.04	6.48	1303
100	13.32	12.72	10.08	1427
125	19.20	18.12	14.28	1548
150	25.68	24.00	18.84	1666
175	32.76	30.36	23.76	1780
200	40.32	37.08	28.92	1890
225	48.36	44.40	34.56	1996
250	59.52	55.20	45.00	*2000
275	72.12	67.44	57.00	*2000
300	85.80	80.88	70.32	*2000

** Note: Design Specification Constraint*

Std. Item:	
Item ID:	9314543
CU:	C10AAACPER/T

Supersedes 7/10 Issue – Updated item ID.

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	4194 lbs.	TRANSVERSE	0.5286 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1081 sq. in.	VERTICAL	0.843 Lb/Ft			
R. (@ 25˚C)	0.1660 Ω / 1000’	TOTAL	1.295 Lb/Ft	228	NORMAL	344
R. (@ 75˚C)	0.1950 Ω / 1000’			278	EMERGENCY	374
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	60.55˚			
CONDUCTOR DIAMETER	0.468”					
COMPLETE DIAMETER	0.588”					
WEIGHT	166 lbs / 1000’					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.60	0.96	1.56	4.20	7.68	11.04	12.36	13.56
75	1.32	2.04	3.48	7.44	12.12	16.92	18.72	20.52
100	2.40	3.60	6.00	11.16	16.92	22.92	25.32	27.60
125	3.72	5.52	8.88	15.12	21.84	29.16	32.16	34.92
150	5.40	7.92	12.24	19.56	27.12	35.52	39.00	42.24
175	7.32	10.56	15.96	24.24	32.64	42.12	46.08	49.92
200	9.48	13.68	20.04	29.16	38.52	48.96	53.40	57.60
225	12.00	17.16	24.48	34.44	44.52	55.92	60.84	65.52
250	14.88	20.88	29.16	39.96	50.76	63.12	68.52	73.56
275	20.40	28.80	38.88	50.64	61.80	74.64	80.16	85.44
300	29.16	40.56	52.20	64.32	75.72	88.68	94.32	99.72

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	4.20	3.96	3.00	1161
75	8.64	8.16	6.00	1261
100	14.16	13.20	9.84	1368
125	20.52	18.84	14.04	1476
150	27.60	25.20	18.84	1582
175	35.28	32.04	24.00	1685
200	43.56	39.36	29.52	1785
225	52.32	47.16	35.28	1882
250	61.44	55.32	41.52	1976
275	73.56	66.72	51.84	*2000
300	87.48	80.28	64.92	*2000
** Note: Design Specification Constraint*				

Std. Item:	W12B
Item ID:	9306923Y
CU:	C02ASSTBR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	2850 lbs.	TRANSVERSE	0.4379 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0608 sq. in.	VERTICAL	0.599 Lb/Ft			
R. (@ 25˚C)	0.2591 Ω / 1000’	TOTAL	1.042 Lb/Ft	183	NORMAL	251
R. (@ 75˚C)	0.3360 Ω / 1000’			203	EMERGENCY	264
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	60.01˚			
CONDUCTOR DIAMETER	0.316”					
WEIGHT	91 lbs.					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.48	0.72	1.20	3.12	4.32	6.24	7.08	7.92
75	1.08	1.56	2.76	5.88	7.56	10.08	11.16	12.36
100	1.92	2.88	4.68	8.88	11.04	14.04	15.48	16.80
125	3.00	4.44	7.08	12.24	14.64	18.00	19.68	21.36
150	4.32	6.36	9.84	15.60	18.36	22.20	24.12	25.92
175	5.88	8.52	12.96	19.20	22.20	26.40	28.44	30.48
200	7.68	11.04	16.32	22.80	26.04	30.48	32.76	35.04
225	10.44	15.24	22.08	28.32	31.92	36.96	39.36	41.88
250	16.80	25.08	34.32	39.12	43.32	48.96	51.60	54.24
275	27.60	38.88	47.40	52.08	56.76	62.76	65.52	68.28
300	43.08	55.32	62.04	66.96	72.00	78.12	80.88	83.76

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	4.68	4.08	2.28	827
75	9.60	8.04	4.80	921
100	15.36	12.96	7.92	1016
125	22.08	18.60	11.52	1109
150	29.40	24.72	15.48	1199
175	37.20	31.32	19.92	1286
200	45.60	38.40	24.60	1370
225	55.56	47.04	31.44	*1425
250	68.64	59.40	43.44	*1425
275	83.04	73.32	57.24	*1425
300	98.88	88.56	72.84	*1425
** Note: Design Specification Constraint*				

Supersedes 7/10 Issue – Updated item ID.

#2, 6/1 STRANDING, BARE ACSR, “SPARROW”
MAINTENANCE ONLY

Std. Item:	
Item ID:	
CU:	C02ASSTPER/T

Supersedes 7/10 Issue – Deleted obsolete item ID.

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	2710 lbs.	TRANSVERSE	0.4978 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0672 sq. in.	VERTICAL	0.739 Lb/Ft			
R. (@ 25˚C)	0.2591 Ω / 1000'	TOTAL	1.191 Lb/Ft	178	NORMAL	266
R. (@ 75˚C)	0.3360 Ω / 1000'			216	EMERGENCY	289
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	64.37˚			
CONDUCTOR DIAMETER	0.406"					
COMPLETE DIAMETER	0.496"					
WEIGHT	119 lbs / 1000'					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.60	0.96	1.80	4.08	5.40	7.08	7.92	8.64
75	1.44	2.28	3.84	7.32	9.00	11.28	12.36	13.44
100	2.64	3.96	6.48	10.92	12.96	15.72	17.04	18.36
125	4.08	6.12	9.48	14.76	17.16	20.28	21.84	23.40
150	5.88	8.64	12.96	18.84	21.48	24.96	26.76	28.44
175	8.04	11.64	16.80	22.92	25.80	29.76	31.68	33.60
200	13.92	20.40	27.84	33.00	36.48	40.92	42.96	45.00
225	24.60	33.84	41.88	45.84	49.68	54.36	56.64	58.80
250	40.20	49.92	56.76	60.84	64.80	69.72	72.00	74.16
275	58.32	67.80	73.56	77.76	81.84	86.76	89.04	91.32
300	78.24	87.36	92.28	96.48	100.56	105.60	107.88	110.16

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	5.40	4.92	3.48	827
75	10.68	9.60	6.84	938
100	17.04	15.12	10.92	1047
125	24.24	21.48	15.48	1152
150	32.16	28.32	20.40	1253
175	40.56	35.64	25.80	1349
200	52.80	47.28	36.84	*1355
225	66.84	60.84	50.28	*1355
250	82.44	76.20	65.64	*1355
275	99.84	93.24	82.80	*1355
300	118.80	111.96	101.64	*1355

** Note: Design Specification Constraint*

#2, 6/1 STRANDING, ACSR, 45 MIL PE COVERING, "PIGNUT"

MAINTENANCE ONLY

Std. Item:	
Item ID:	
CU:	C04ASBR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	2360 lbs.	TRANSVERSE	0.4191 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0411 sq. in.	VERTICAL	0.538 Lb/Ft			
R. (@ 25˚C)	0.4070 Ω / 1000’	TOTAL	0.982 Lb/Ft	140	NORMAL	191
R. (@ 75˚C)	0.5160 Ω / 1000’			155	EMERGENCY	201
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	62.46˚			
CONDUCTOR DIAMETER	0.257”					
WEIGHT	67 lbs.					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.48	0.60	0.84	1.80	3.00	4.92	5.88	6.84
75	0.96	1.32	1.92	3.72	5.52	8.04	9.36	10.68
100	1.68	2.28	3.48	6.12	8.40	11.40	12.96	14.52
125	2.64	3.60	5.28	8.88	11.28	14.76	16.68	18.48
150	3.84	5.28	7.44	11.88	14.28	18.24	20.28	22.32
175	5.16	7.08	9.96	14.64	17.40	21.60	23.88	26.16
200	7.08	9.72	13.68	18.36	21.60	26.28	28.68	31.20
225	11.40	16.32	23.16	27.00	31.08	36.72	39.48	42.24
250	20.28	29.16	35.28	40.08	44.88	51.00	53.88	56.64
275	35.76	45.96	50.76	55.92	61.08	67.32	70.20	72.96
300	55.44	63.72	68.64	73.92	79.08	85.20	88.08	90.84

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	5.28	4.08	1.80	697
75	10.56	8.28	3.96	781
100	17.04	13.44	6.72	865
125	24.24	19.32	9.96	948
150	32.28	25.80	13.68	1027
175	40.92	32.76	17.76	1104
200	50.52	40.80	23.16	1166
225	63.24	52.32	33.36	*1180
250	78.12	66.36	47.40	*1180
275	94.44	82.20	63.60	*1180
300	112.44	99.60	81.60	*1180

** Note: Design Specification Constraint*

Supersedes 7/09 Issue – Updated item ID.

Std. Item:	
CU:	C04ASPE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	2240 lbs.	**TRANSVERSE**	0.4589 Lb/Ft	**SUMMER (37.7˚C)**	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
C.S.A.	0.0439 sq. in.	**VERTICAL**	0.627 Lb/Ft			
R. (@ 25˚C)	0.4072 Ω / 1000’	**TOTAL**	1.077 Lb/Ft	136	**NORMAL**	200
R. (@ 75˚C)	0.5160 Ω / 1000’			164	**EMERGENCY**	217
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	**SWING**	66.49˚			
CONDUCTOR DIAMETER	0.317”					
COMPLETE DIAMETER	0.377”					
WEIGHT	82 lbs / 1000’					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	0.60	0.84	1.32	2.88	4.44	6.36	7.32	8.16
75	1.20	1.80	2.76	5.52	7.56	10.20	11.40	12.60
100	2.16	3.12	4.80	8.64	10.92	14.04	15.60	17.04
125	3.48	4.92	7.32	11.88	14.40	18.00	19.80	21.48
150	4.92	6.96	10.20	15.12	18.00	22.08	24.00	26.04
175	7.68	11.28	16.32	21.24	24.72	29.40	31.56	33.72
200	15.12	22.32	29.52	33.48	37.44	42.48	44.76	47.04
225	29.16	38.28	44.16	48.36	52.56	57.60	59.88	62.16
250	47.76	56.52	61.20	65.52	69.60	74.64	76.92	79.20
275	68.16	76.20	80.28	84.48	88.56	93.60	95.88	98.16
300	90.00	97.20	101.16	105.36	109.44	114.36	116.64	118.80

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			**TENSION (LBS.)**
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-20**	**0**	**15**	**-20**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	5.76	4.92	2.88	697
75	11.40	9.60	5.88	795
100	18.12	15.24	9.60	892
125	25.68	21.60	13.80	984
150	33.96	28.44	18.36	1072
175	44.16	37.68	25.92	*1120
200	57.72	50.52	38.52	*1120
225	73.08	65.40	53.40	*1120
250	90.24	82.08	70.44	*1120
275	109.32	100.80	89.28	*1120
300	130.08	121.32	110.04	*1120
** Note: Design Specification Constraint*				

Supersedes 17/09Issue – Deleted obsolete item ID.

#4, 7/1 STRANDING, ACSR, 30 MIL PE COVERING, “HICKORY”

MAINTENANCE ONLY

Std. Item:	
Item ID:	
CU:	C04ASPE6NE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	1770 lbs.	TRANSVERSE	0.4577 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0411 sq. in.	VERTICAL	0.613 Lb/Ft			
R. (@ 25˚C)	0.4120 Ω / 1000’	TOTAL	1.065 Lb/Ft	135	NORMAL	199
R. (@ 75˚C)	0.5220 Ω / 1000’			163	EMERGENCY	216
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	68.73˚			
CONDUCTOR DIAMETER	0.310”					
COMPLETE DIAMETER	0.370”					
WEIGHT	72 lbs / 1000’					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.60	0.96	1.56	3.48	4.56	6.36	7.20	7.92
75	1.32	2.04	3.48	6.12	7.68	9.84	11.04	12.12
100	2.40	3.60	5.76	9.00	10.80	13.44	14.76	16.08
125	3.84	5.64	8.76	12.00	14.04	17.04	18.60	20.16
150	7.92	12.48	17.76	20.40	23.16	26.88	28.56	30.36
175	19.32	27.36	30.60	33.84	37.08	41.04	42.84	44.64
200	37.92	43.80	47.04	50.40	53.76	57.72	59.64	61.44
225	58.68	63.00	66.24	69.60	72.84	76.92	78.72	80.52
250	81.00	84.72	87.84	91.08	94.32	98.28	100.08	102.00
275	105.00	108.60	111.72	114.96	118.08	122.04	123.84	125.64
300	131.28	134.76	137.76	141.00	144.12	147.96	149.88	151.56

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	6.72	5.76	3.60	591
75	13.08	11.04	7.20	688
100	20.52	17.28	11.28	780
125	28.80	24.24	16.08	866
150	40.68	35.28	26.16	*885
175	55.32	49.32	40.32	*885
200	72.24	65.88	57.12	*885
225	91.44	84.84	76.32	*885
250	112.92	106.08	97.80	*885
275	136.80	129.72	121.44	*885
300	162.84	155.64	147.48	*885

** Note: Design Specification Constraint*

Supersedes 1/07 Issue - Updated CU.

#4, 6/1 STRANDING, ACSR, 30 MIL PE COVERING, “BUTTERNUT”
MAINTENANCE ONLY

Non-Standard Copper Overhead Distribution Conductors

Maintenance Only

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	9160 lbs.	TRANSVERSE	0.5068 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.1663 sq. in.	VERTICAL	1.290 Lb/Ft			
R. (@ 25˚C)	0.0527 Ω / 1000’	TOTAL	1.686 Lb/Ft	486	NORMAL	679
R. (@ 50˚C)	0.0574 Ω / 1000’			545	EMERGENCY	718
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	21.76˚			
CONDUCTOR DIAMETER	0.522”					
WEIGHT	654 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.32	2.28	4.20	6.72	8.88	11.16	12.12	12.96
75	3.36	5.64	8.64	11.88	14.76	17.88	19.20	20.40
100	6.96	10.68	14.40	18.24	21.72	25.44	27.12	28.68
125	12.48	17.52	21.84	26.04	29.88	34.32	36.24	38.04
150	20.28	25.92	30.60	35.28	39.48	44.28	46.44	48.60
175	30.12	36.12	41.04	45.84	50.40	55.68	57.96	60.24
200	41.76	47.88	52.92	57.96	62.76	68.40	70.92	73.32
225	54.96	61.32	66.48	71.64	76.56	82.44	85.08	87.72
250	69.96	76.32	81.60	86.88	91.92	98.04	100.80	103.56
275	86.52	92.88	98.16	103.68	108.84	115.20	118.08	120.84
300	104.64	111.12	116.40	121.92	127.32	133.80	136.68	139.56

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	3.12	3.84	4.32	*2000
75	7.08	8.28	8.76	*2000
100	12.60	14.16	14.76	*2000
125	19.80	21.60	22.08	*2000
150	28.44	30.48	30.96	*2000
175	38.76	40.92	41.40	*2000
200	50.64	52.92	53.28	*2000
225	64.08	66.48	66.84	*2000
250	79.08	81.48	81.96	*2000
275	95.76	98.28	98.64	*2000
300	114.00	116.52	116.88	*2000

** Note: Design Specification Constraint*

Std. Item:	W13K
Item ID:	9315933
CU:	C10BSTC

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	4752 lbs.	TRANSVERSE	0.4566 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0829 sq. in.	VERTICAL	0.866 Lb/Ft			
R. (@ 25˚C)	0.1051 Ω / 1000'	TOTAL	1.279 Lb/Ft	313	NORMAL	432
R. (@ 50˚C)	0.1150 Ω / 1000'			350	EMERGENCY	457
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	29.44˚			
CONDUCTOR DIAMETER	0.368"					
WEIGHT	326 lbs.					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.08	1.56	2.64	4.92	7.32	9.96	10.92	11.88
75	2.28	3.48	5.40	8.52	11.88	15.36	16.92	18.24
100	4.08	6.00	8.76	12.72	16.68	21.12	23.04	24.84
125	6.48	9.12	12.72	17.40	21.96	27.24	29.52	31.68
150	9.24	12.84	17.16	22.44	27.72	33.72	36.36	38.88
175	12.60	17.04	22.08	27.96	33.84	40.56	43.56	46.32
200	16.44	21.72	27.48	33.96	40.20	47.64	51.00	54.12
225	23.04	29.76	36.24	43.20	49.92	57.72	61.20	64.56
250	32.28	40.08	47.04	54.36	61.32	69.48	73.08	76.68
275	43.44	51.96	59.40	66.84	73.92	82.32	86.16	89.76
300	56.40	65.40	72.84	80.52	87.72	96.36	100.20	104.04

Supersedes 7/09 Issue - Updated item ID.

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	3.60	3.60	2.88	1314
75	7.56	7.32	5.88	1426
100	12.48	11.88	9.48	1542
125	18.12	17.16	13.68	1658
150	24.36	22.92	18.36	1770
175	31.32	29.28	23.52	1877
200	38.76	36.12	29.04	1980
225	48.60	45.60	37.92	*2000
250	60.00	56.76	48.84	*2000
275	72.60	69.24	61.08	*2000
300	86.40	82.80	74.64	*2000

** Note: Design Specification Constraint*

1/0, 7 STRAND, HARD DRAWN COPPER, BARE

MAINTENANCE ONLY

PHYSICAL PROPERTIES	
R.B.S.	4752 lbs.
C.S.A.	0.0942 sq. in.
R. (@ 25˚C)	0.1051 Ω / 1000’
R. (@ 50˚C)	0.1150 Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.368”
COMPLETE DIAMETER	0.488”
WEIGHT	363 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.4947 Lb/Ft
VERTICAL	0.978 Lb/Ft
TOTAL	1.396 Lb/Ft
SWING	33.91˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
278	NORMAL	415
337	EMERGENCY	452

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.20	1.80	3.36	5.88	8.16	10.56	11.52	12.48
75	2.52	4.08	6.48	9.84	12.96	16.32	17.76	19.08
100	4.56	6.84	10.20	14.28	18.12	22.44	24.24	25.92
125	7.20	10.44	14.40	19.20	23.64	28.80	30.96	33.12
150	10.32	14.52	19.20	24.60	29.76	35.52	38.16	40.56
175	14.04	19.08	24.48	30.48	36.12	42.72	45.60	48.36
200	21.00	27.48	33.60	39.96	45.96	52.92	55.92	58.92
225	30.36	37.80	44.40	51.00	57.24	64.44	67.68	70.80
250	41.88	49.80	56.64	63.36	69.72	77.28	80.64	83.88
275	55.08	63.36	70.20	77.04	83.64	91.32	94.80	98.28
300	69.96	78.24	85.20	92.16	98.76	106.68	110.28	113.76

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	3.84	4.08	3.72	1349
75	7.92	8.04	7.08	1482
100	12.96	12.84	11.04	1617
125	18.72	18.36	15.60	1748
150	25.20	24.48	20.64	1873
175	32.28	31.08	26.28	1991
200	41.88	40.56	35.40	*2000
225	53.04	51.60	46.20	*2000
250	65.52	63.96	58.44	*2000
275	79.20	77.64	72.00	*2000
300	94.32	92.64	87.00	*2000

** Note: Design Specification Constraint*

Std. Item:	W13D
Item ID:	9315669Y
CU:	C02CUSTBR

Supersedes 7/09 Issue - Updated item ID.

PHYSICAL PROPERTIES	
R.B.S.	5876 lbs.
C.S.A.	0.0680 sq. in.
R. (@ 25˚C)	0.1653 Ω / 1000'
R. (@ 50˚C)	0.1809 Ω / 1000'
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.366"
WEIGHT	257 lbs.

LOADING PROPERTIES	
TRANSVERSE	0.4553 Lb/Ft
VERTICAL	0.796 Lb/Ft
TOTAL	1.217 Lb/Ft
SWING	35.45˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
249	NORMAL	344
279	EMERGENCY	363

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.60	0.84	1.20	1.92	3.60	6.60	7.80	9.00
75	1.44	1.92	2.64	3.96	6.60	10.68	12.36	13.92
100	2.64	3.36	4.56	6.72	10.08	15.00	17.16	19.20
125	4.08	5.28	6.96	9.96	14.04	19.80	22.32	24.72
150	5.88	7.56	9.84	13.56	18.36	24.84	27.72	30.48
175	8.16	10.44	13.56	18.00	23.52	30.60	33.84	36.84
200	12.00	15.48	19.80	25.44	31.68	39.24	42.72	45.96
225	17.16	22.32	27.84	34.44	41.16	49.08	52.68	56.04
250	24.48	31.08	37.68	44.88	51.84	60.12	63.72	67.32
275	33.96	41.76	48.96	56.52	63.60	72.12	75.96	79.56
300	45.60	54.24	61.68	69.36	76.68	85.32	89.16	93.00

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	3.00	2.52	1.44	1548
75	6.36	5.40	3.12	1628
100	10.56	9.12	5.52	1721
125	15.72	13.56	8.28	1819
150	21.36	18.60	11.64	1918
175	27.96	24.36	15.72	*2000
200	36.48	32.28	22.44	*2000
225	46.20	41.52	30.72	*2000
250	57.12	51.96	40.56	*2000
275	69.00	63.60	51.96	*2000
300	82.20	76.44	64.56	*2000
* Note: Design Specification Constraint				

#2, 3 STRAND, TYPE A COPPER – COPPERWELD, BARE

MAINTENANCE ONLY

Std. Item:	W13B
Item ID:	9315684
CU:	C02CHSTBR

PHYSICAL PROPERTIES	
R.B.S.	3050 lbs.
C.S.A.	0.0522 sq. in.
R. (@ 25˚C)	0.1670 Ω / 1000'
R. (@ 50˚C)	0.1826 Ω / 1000'
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.292"
WEIGHT	205 lbs.

LOADING PROPERTIES	
TRANSVERSE	0.4303 Lb/Ft
VERTICAL	0.698 Lb/Ft
TOTAL	1.1207 Lb/Ft
SWING	35.46˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
234	NORMAL	321
261	EMERGENCY	339

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.96	1.56	2.52	4.80	7.20	9.84	10.92	11.88
75	2.28	3.36	5.16	8.40	11.64	15.24	16.68	18.12
100	4.08	5.88	8.52	12.48	16.44	21.00	22.92	24.72
125	6.36	8.88	12.48	17.04	57.72	27.00	29.28	31.56
150	9.12	12.48	16.80	22.08	27.36	33.48	36.12	38.64
175	12.36	16.68	21.60	27.60	33.36	40.20	43.20	46.08
200	16.08	21.36	26.88	33.48	39.72	47.28	50.52	53.76
225	22.44	29.04	35.52	42.48	49.20	57.12	60.60	63.96
250	33.12	41.04	48.00	55.32	62.16	70.20	73.80	77.40
275	46.44	54.96	62.28	69.60	76.56	84.72	88.44	92.04
300	61.92	70.68	78.00	85.32	92.28	100.56	104.40	108.00

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.68	4.32	3.00	898
75	9.36	8.52	6.00	1003
100	15.12	13.56	9.60	1108
125	21.72	19.32	13.80	1210
150	28.92	25.68	18.60	1306
175	36.84	32.64	23.76	1398
200	45.24	40.08	29.40	1486
225	55.80	49.92	38.16	*1525
250	68.88	62.52	50.64	*1525
275	83.40	76.68	64.68	*1525
300	99.24	92.28	80.28	*1525

** Note: Design Specification Constraint*

Supersedes 7/09 Issue - Updated item ID.

#2, 7 STRAND, HARD DRAWN COPPER, BARE
MAINTENANCE ONLY

Std. Item:	W13E
Item ID:	9312556
CU:	C02CHSTPE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	3050 lbs.	TRANSVERSE	0.4601 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0585 sq. in.	VERTICAL	0.777 Lb/Ft			
R. (@ 25˚C)	0.1670 Ω / 1000’	TOTAL	1.203 Lb/Ft	213	NORMAL	314
R. (@ 50˚C)	0.1826 Ω / 1000’			257	EMERGENCY	342
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	39.95˚			
CONDUCTOR DIAMETER	0.292”					
COMPLETE DIAMETER	0.382”					
WEIGHT	228 lbs / 1000’					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.08	1.80	3.12	5.64	7.92	10.44	11.40	12.36
75	2.52	3.84	6.24	9.48	12.72	16.08	17.52	18.84
100	4.44	6.72	9.84	13.92	17.76	22.08	24.00	25.68
125	6.96	10.08	14.04	18.84	23.28	28.44	30.72	32.76
150	10.08	14.16	18.72	24.12	29.28	35.16	37.68	40.20
175	13.68	18.60	24.00	29.88	35.64	42.24	45.12	47.88
200	19.92	26.16	32.16	38.64	44.64	51.72	54.84	57.84
225	30.36	37.92	44.40	51.00	57.24	64.44	67.68	70.80
250	43.68	51.60	58.20	64.92	71.16	78.60	81.96	85.20
275	59.04	67.08	73.68	80.40	86.64	94.20	97.68	100.92
300	76.08	84.00	90.60	97.32	103.68	111.36	114.84	118.20

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	4.92	4.68	3.72	926
75	9.72	9.12	7.08	1046
100	15.48	14.40	11.16	1163
125	22.08	20.40	15.84	1274
150	29.40	27.00	20.88	1380
175	37.44	34.08	26.52	1479
200	47.40	43.56	35.04	*1525
225	60.00	55.80	47.16	*1525
250	74.04	69.60	60.84	*1525
275	89.52	84.96	76.20	*1525
300	106.56	101.88	93.12	*1525
* Note: Design Specification Constraint				

Supersedes 7/09 Issue - Updated drawing title.

#2, 7 STRAND, SOFT DRAWN COPPER, 45 MIL PE COVERING
MAINTENANCE ONLY

Std. Item:	W11G
Item ID:	9302814[E]
CU:	C03CHSTBRNE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	2433 lbs.	TRANSVERSE	0.4197 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0416 sq. in.	VERTICAL	0.636 Lb/Ft			
R. (@ 25˚C)	0.2106 Ω / 1000’	TOTAL	1.062 Lb/Ft	202	NORMAL	277
R. (@ 50˚C)	0.2303 Ω / 1000’			226	EMERGENCY	292
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	38.57˚			
CONDUCTOR DIAMETER	0.260”					
WEIGHT	163 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.96	1.56	2.52	4.80	7.20	9.84	10.80	11.88
75	2.28	3.36	5.16	8.28	11.64	15.24	16.68	18.12
100	3.96	5.76	8.52	12.48	16.44	21.00	22.92	24.72
125	6.24	8.88	12.36	17.04	21.72	27.00	29.28	31.44
150	9.00	12.48	16.80	22.08	27.36	33.36	36.12	38.64
175	12.36	16.80	21.72	27.72	33.48	40.32	43.32	46.08
200	20.76	27.24	33.24	39.60	45.60	52.56	55.68	58.68
225	33.00	40.56	46.92	53.40	59.40	66.48	69.72	72.72
250	48.36	56.04	62.40	68.88	74.88	82.08	85.32	88.44
275	65.76	73.44	79.68	86.04	92.04	99.24	102.48	105.72
300	84.96	92.40	98.52	104.88	110.88	118.08	121.44	124.68

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	5.28	4.68	3.00	749
75	10.56	9.24	6.12	851
100	16.80	14.64	9.84	950
125	23.88	20.76	14.16	1045
150	31.56	27.48	18.96	1134
175	40.08	34.80	24.36	*1216
200	52.44	46.56	35.76	*1217
225	66.36	60.00	49.32	*1217
250	81.96	75.24	64.68	*1216
275	99.12	92.28	81.72	*1217
300	117.96	110.88	100.56	*1217

** Note: Design Specification Constraint*

Supersedes 7/09 Issue - Updated item ID.

Std. Item:	W11H
Item ID:	9302709[E]
CU:	C03CHSTPENE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	2433 lbs.	**TRANSVERSE**	0.4490 Lb/Ft	**SUMMER (37.7˚C)**	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
C.S.A.	0.0480 sq. in.	**VERTICAL**	0.704 Lb/Ft			
R. (@ 25˚C)	0.2106 Ω / 1000’	**TOTAL**	1.135 Lb/Ft	185	**NORMAL**	272
R. (@ 50˚C)	0.2303 Ω / 1000’			223	**EMERGENCY**	296
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	**SWING**	45.00˚			
CONDUCTOR DIAMETER	0.260”					
COMPLETE DIAMETER	0.350”					
WEIGHT	175 lbs / 1000’					

FINAL SAG TABLE							
	LOADING (UNLOADED CONDITIONS)						
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**
TEMP. ˚C	**-20**	**0**	**15**	**32**	**50**	**70**	**80**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)							
50	1.20	1.80	3.00	5.40	7.68	10.20	11.16
75	2.76	3.96	6.12	9.24	12.36	15.84	17.28
100	4.80	6.96	9.84	13.68	17.52	21.84	23.64
125	7.56	10.44	14.16	18.72	23.16	28.20	30.36
150	10.80	14.64	19.08	24.24	29.16	34.92	37.56
175	19.20	24.96	30.24	35.76	40.92	46.92	49.56
200	31.80	38.40	43.92	49.56	54.72	60.84	63.60
225	47.52	54.12	59.64	65.28	70.44	76.68	79.44
250	65.40	71.88	77.28	82.80	88.08	94.32	97.20
275	85.20	91.56	96.84	102.36	107.52	113.88	116.76
300	106.80	113.04	118.32	123.72	128.88	135.24	138.24

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			**TENSION (LBS.)**
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-20**	**0**	**15**	**-20**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	5.52	5.16	3.96	779
75	10.68	9.84	7.44	896
100	16.92	15.36	11.52	1007
125	24.00	21.60	16.20	1112
150	31.68	28.44	21.36	1210
175	42.84	39.12	31.80	*1217
200	56.04	51.96	44.52	*1216
225	70.92	66.60	59.28	*1217
250	87.60	83.16	75.84	*1217
275	105.96	101.40	94.20	*1217
300	126.24	121.44	114.24	*1217
** Note: Design Specification Constraint*				

Supersedes 7/09 Issue - Updated item ID.

#3, 7 STRAND, HARD DRAWN COPPER, 45 MIL PE COVERING
MAINTENANCE ONLY

Std. Item:	W11D
Item ID:	9315668Y
CU:	C04CUSTBR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	3938 lbs.	**TRANSVERSE**	0.4302 Lb/Ft	**SUMMER (37.7˚C)**	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
C.S.A.	0.0428 sq. in.	**VERTICAL**	0.653 Lb/Ft			
R. (@ 25˚C)	0.2629 Ω / 1000’	**TOTAL**	1.082 Lb/Ft	186	**NORMAL**	255
R. (@ 50˚C)	0.2875 Ω / 1000’			208	**EMERGENCY**	270
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	**SWING**	41.83˚			
CONDUCTOR DIAMETER	0.290”					
WEIGHT	162 lbs.					

FINAL SAG TABLE

	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	0.60	0.84	1.08	1.56	3.00	5.88	7.32	8.40
75	1.44	1.80	2.40	3.48	5.76	9.72	11.52	13.20
100	2.52	3.12	4.20	6.00	9.00	13.92	16.08	18.24
125	3.84	4.92	6.36	8.88	12.72	18.48	21.00	23.52
150	5.52	7.08	9.00	12.36	16.80	23.28	26.28	29.04
175	7.56	9.60	12.12	16.08	21.24	28.44	31.68	34.92
200	9.84	12.36	15.60	20.28	26.04	33.84	37.44	40.92
225	12.48	15.60	19.32	24.72	31.08	39.60	43.44	47.28
250	15.48	19.08	23.52	29.52	36.48	45.48	49.68	53.76
275	18.72	23.04	27.96	34.56	42.00	51.72	56.16	60.60
300	22.20	27.24	32.76	39.96	47.88	58.20	63.00	67.56

FINAL SAG TABLE

	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-20**	**0**	**15**	**-20**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	3.84	3.00	1.44	1069
75	7.92	6.36	3.12	1148
100	13.20	10.56	5.40	1235
125	19.20	15.60	8.16	1323
150	25.92	21.12	11.52	1411
175	33.24	27.24	15.24	1497
200	41.04	33.84	19.32	1581
225	49.44	40.92	23.88	1663
250	58.32	48.36	28.68	1742
275	67.56	56.16	33.84	1819
300	77.16	64.32	39.36	1894

** Note: Design Specification Constraint*

Supersedes 7/09 Issue - Updated item ID.

Std. Item:	W11B
Item ID:	9315667[Y]
CU:	C04CHSOBR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	1970 lbs.	TRANSVERSE	0.4010 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0328 sq. in.	VERTICAL	0.564 Lb/Ft			
R. (@ 25˚C)	0.2602 Ω / 1000'	TOTAL	0.992 Lb/Ft	171	NORMAL	232
R. (@ 50˚C)	0.2847 Ω / 1000'			190	EMERGENCY	245
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	38.97˚			
CONDUCTOR DIAMETER	0.204"					
WEIGHT	126 lbs.					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.96	1.44	2.40	4.56	7.08	9.72	10.80	11.76
75	2.16	3.12	4.92	8.04	11.40	15.00	16.56	18.00
100	3.84	5.52	8.16	12.12	16.08	20.76	22.68	24.48
125	6.00	8.52	11.88	16.56	21.24	26.64	29.04	31.20
150	8.64	12.00	16.20	21.60	26.88	33.00	35.76	38.28
175	16.32	22.08	27.72	33.60	39.00	45.36	48.12	50.76
200	29.04	36.00	41.88	47.64	53.16	59.40	62.28	65.04
225	45.24	52.32	57.96	63.72	69.12	75.48	78.36	81.12
250	63.72	70.56	76.08	81.72	87.12	93.48	96.36	99.24
275	84.12	90.60	96.12	101.64	106.92	113.28	116.28	119.16
300	106.32	112.68	117.96	123.36	128.64	135.12	138.00	140.88

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	5.88	5.04	2.88	635
75	11.52	9.72	5.88	733
100	18.24	15.36	9.48	826
125	25.68	21.60	13.68	913
150	33.96	28.68	18.48	*985
175	46.32	40.32	29.76	*985
200	60.48	54.00	43.68	*985
225	76.56	69.72	59.76	*985
250	94.56	87.36	77.76	*985
275	114.48	107.04	97.56	*985
300	136.20	128.76	119.40	*985
** Note: Design Specification Constraint*				

Supersedes 7/09 Issue - Updated item ID.

Std. Item:	W11E
Item ID:	9312557Y
CU:	C04CHSOPE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	1970 lbs.	TRANSVERSE	0.4210 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0356 sq. in.	VERTICAL	0.611 Lb/Ft			
R. (@ 25˚C)	0.2602 Ω / 1000'	TOTAL	1.042 Lb/Ft	159	NORMAL	230
R. (@ 50˚C)	0.2847 Ω / 1000'			191	EMERGENCY	250
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	44.33˚			
CONDUCTOR DIAMETER	0.204"					
COMPLETE DIAMETER	0.264"					
WEIGHT	135 lbs / 1000'					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.08	1.56	2.52	4.68	7.20	9.72	10.80	11.76
75	2.28	3.36	5.28	8.28	11.52	15.12	16.68	18.00
100	4.08	5.88	8.64	12.48	16.44	20.88	22.80	24.60
125	6.48	9.00	12.48	17.04	21.72	27.00	29.28	31.44
150	10.20	14.04	18.60	23.88	28.92	34.92	37.44	39.96
175	19.44	25.56	30.96	36.60	41.76	47.76	50.40	52.92
200	33.72	40.44	45.96	51.48	56.52	62.64	65.28	67.92
225	51.00	57.60	62.88	68.28	73.44	79.44	82.20	84.84
250	70.32	76.68	81.84	87.24	92.28	98.28	101.16	103.80
275	91.68	97.80	102.84	108.12	113.16	119.16	122.04	124.68
300	114.84	120.84	125.76	130.92	135.96	142.08	144.84	147.60

Supersedes 7/09 Issue - Updated item ID.

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	6.12	5.28	3.24	641
75	11.88	10.20	6.48	741
100	18.72	16.08	10.44	835
125	26.40	22.56	14.88	925
150	35.76	30.84	21.48	*985
175	48.60	43.20	33.72	*985
200	63.48	57.72	48.36	*985
225	80.40	74.28	65.16	*985
250	99.24	92.88	84.00	*985
275	120.24	113.64	104.88	*985
300	143.04	136.32	127.68	*985
** Note: Design Specification Constraint*				

#4, SOLID, HARD DRAWN COPPER, 30 MIL PE COVERING
MAINTENANCE ONLY

Std. Item:	W9F
Item ID:	9315670Y
CU:	C6ABCCW

Supersedes 1/07 Issue - Updated item ID.

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	2585 lbs.	TRANSVERSE	0.4103 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0269 sq. in.	VERTICAL	0.556 Lb/Ft			
R. (@ 25˚C)	0.4186 Ω / 1000’	TOTAL	0.991 Lb/Ft	140	NORMAL	190
R. (@ 50˚C)	0.4564 Ω / 1000’			155	EMERGENCY	201
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	48.43˚			
CONDUCTOR DIAMETER	0.230”					
WEIGHT	102 lbs.					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.60	0.72	0.96	1.44	2.52	5.40	6.84	8.04
75	1.32	1.68	2.16	3.24	5.16	9.12	10.92	12.60
100	2.40	3.00	3.84	5.52	8.28	13.08	15.36	17.52
125	3.72	4.68	6.00	8.28	11.88	17.52	20.16	22.68
150	5.28	6.72	8.52	11.52	15.84	22.20	25.20	28.08
175	7.20	9.12	11.40	15.12	20.04	27.24	30.60	33.72
200	9.48	11.76	14.76	19.08	24.72	32.52	36.12	39.72
225	12.00	14.88	18.36	23.40	29.64	38.04	42.00	45.84
250	17.16	21.48	26.64	33.12	40.32	49.32	53.40	57.36
275	26.52	33.24	40.08	47.76	55.32	64.32	68.40	72.36
300	40.44	48.84	56.52	64.44	71.88	80.88	84.96	88.80

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	5.04	3.72	1.44	740
75	10.20	7.80	3.24	818
100	16.56	12.72	5.64	899
125	23.76	18.48	8.52	978
150	31.68	24.84	12.00	1055
175	40.32	31.80	15.84	1130
200	49.44	39.24	20.04	1202
225	59.16	47.16	24.72	1272
250	71.88	58.56	33.84	*1292
275	87.00	72.72	47.28	*1293
300	103.56	88.44	63.24	*1293
** Note: Design Specification Constraint*				

#6, 3 STRAND, TYPE A COPPER – COPPERWELD, BARE
MAINTENANCE ONLY

Std. Item:	
Item ID:	
CU:	C06CHSOBR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	1280 lbs.	TRANSVERSE	0.3867 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0234 sq. in.	VERTICAL	0.491 Lb/Ft			
R. (@ 25˚C)	0.4129 Ω / 1000’	TOTAL	0.925 Lb/Ft	128	NORMAL	173
R. (@ 50˚C)	0.4527 Ω / 1000’			142	EMERGENCY	182
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)	SWING	45.72˚			
CONDUCTOR DIAMETER	0.162”					
WEIGHT	79 lbs.					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.96	1.32	2.28	4.32	6.84	9.48	10.56	11.52
75	2.04	3.00	4.68	7.68	11.04	14.76	16.32	17.76
100	3.72	5.28	7.80	11.64	15.72	20.28	22.32	24.12
125	9.24	13.56	18.12	22.68	26.88	31.56	33.72	35.64
150	23.40	29.04	33.48	37.80	41.88	46.44	48.60	50.52
175	42.24	47.40	51.48	55.56	59.52	64.08	66.24	68.28
200	63.48	68.16	72.12	76.08	79.92	84.48	86.52	88.68
225	87.12	91.56	95.40	99.24	102.96	107.52	109.68	111.72
250	113.40	117.72	121.32	125.16	128.88	133.44	135.48	137.64
275	142.20	146.40	150.00	153.72	157.44	162.00	164.16	166.20
300	173.76	177.84	181.44	185.16	188.76	193.32	195.48	197.52

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	7.44	6.00	3.00	463
75	14.28	11.52	6.00	548
100	22.08	17.88	9.72	628
125	33.96	28.68	20.04	*640
150	48.84	43.08	34.92	*640
175	66.48	60.48	52.80	*640
200	86.88	80.64	73.20	*640
225	110.04	103.56	96.48	*640
250	135.84	129.24	122.40	*640
275	164.52	157.80	150.96	*640
300	195.96	189.12	182.40	*640
Note: Design Specification Constraint				

Supersedes 7/09 Issue – Deleted obsolete item ID.

#6, SOLID, HARD DRAWN COPPER, BARE
MAINTENANCE ONLY

Std. Item:	W9E
Item ID:	9312558
CU:	C06CHSOPE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	1280 lbs.	TRANSVERSE	0.4070 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0234 sq. in.	VERTICAL	0.536 Lb/Ft			
R. (@ 25˚C)	0.4129 Ω / 1000'	TOTAL	0.973 Lb/Ft	120	NORMAL	173
R. (@ 50˚C)	0.4527 Ω / 1000'			144	EMERGENCY	189
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	51.91˚			
CONDUCTOR DIAMETER	0.162"					
COMPLETE DIAMETER	0.222"					
WEIGHT	87 lbs / 1000'					

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.96	1.56	2.76	5.28	7.68	10.20	11.16	12.12
75	2.28	3.48	5.64	9.00	12.24	15.72	17.16	18.60
100	4.80	7.32	10.92	15.00	18.84	23.04	24.84	26.52
125	14.52	19.68	23.88	27.96	31.68	35.88	37.68	39.48
150	31.08	35.88	39.84	43.68	47.28	51.60	53.52	55.32
175	50.40	54.96	58.56	62.28	65.88	70.08	72.00	73.92
200	72.36	76.68	80.16	83.76	87.36	91.56	93.48	95.40
225	97.08	101.16	104.52	108.12	111.60	115.92	117.84	119.76
250	124.44	128.40	131.88	135.36	138.84	143.04	145.08	147.00
275	154.68	158.64	162.00	165.48	168.96	173.16	175.20	177.12
300	187.80	191.76	195.00	198.48	201.96	206.16	208.20	210.12

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-20	0	15	-20
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	7.56	6.36	3.84	484
75	14.28	11.88	7.44	577
100	22.80	19.44	13.20	*640
125	35.64	31.68	25.68	*640
150	51.36	47.16	41.40	*640
175	69.96	65.52	60.00	*640
200	91.44	86.76	81.48	*640
225	115.80	111.00	105.84	*640
250	143.04	138.24	133.08	*640
275	173.16	168.24	163.20	*640
300	206.16	201.24	196.20	*640
* *Note: Design Specification Constraint*				

Supersedes 1/07 Issue - Updated item ID.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
6	7/21	• Added Table 3 to 6-6 • Updated drawing title on 6-306		
5	7/18	• Corrected Description of “Planetree to AAAC in index. • Corrected Description in title block to “AAAC. 225’ spans” on 6-210. •		
4	7/17	• Corrected spelling of “Azusa” in Index and in titles on pages 6-125 and 6-126. • Corrected reference for conductor data used in calculation – Section 6.2.40. • Corrected normal rating temperature on page 6-111. • Corrected sag-tension data for standard tree wires on pages 6-105 through 6-110, 6-113 through 6-118 and 6-121 through 6-130.		
3	7/15	• Updated item IDs throughout standard.		
2	7/10	• Corrected final unloaded sags for 200’ and 225’ spans on pages 6-203, and 6-205 through 6-217.		
1	7/09	• Updated CUs on pages 6-127, 6-128, 6-203, 6-205, 6-208, 6-212, 6-213, 6-214, 6-215, 6-216, 6-217, 6-218, 6-219, 6-220, 6-302, 6-304, 6-305, 6-306, 6-307, 6-308, 6-309, 6-311, 6-313. • Updated conductor ampacities on pages 6-107, 6-109, 6-115, 6-117, 6-123, 6-127, 6-129.		

Supersedes 7/08 - –Revised clearance to swimming pools.

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Supersedes 7/08 Issue – Deleted reference to nonexistent EOP in 7.0.30.

Supersedes 1/06 Issue – Editorial and paging revisions.

7.0 INTRODUCTION

7.0.10 Role of the National Electrical Safety Code

The National Electrical Safety Code (NESC) provides basic guidance for minimum clearances to protect the public and employees during the installation, maintenance and operation of electric supply and communication lines, and associated equipment. The NESC is not intended as a design specification or an instruction manual.

7.0.20 Role of this Standard

This standard is intended as a design specification to provide for compliance with the NESC, safe installation, operation and maintenance of lines, an adequate level of service reliability, and space for future equipment or conductors. New poles shall be selected to meet or exceed the clearances shown, which shall be considered as minimum requirements.

7.0.30 Clearance Requirements for Distribution Lines

Each vertical and horizontal clearance shall be observed, but within the limits of each other only.

The uniform clearance system contained in the NESC is based on the dimensions of the expected activities in each area, as well as the relative potential problem caused by each type of facility.

Conductor clearance is stated in terms of the "closest approach." This is the clear distance between surfaces that **must** be maintained under specified conditions.

In general, vertical clearance requirements must be met during maximum sag conditions to provide for the expected activity beneath the line.

In general, horizontal clearance requirements must be met with the conductor at rest to provide for the expected activity alongside the line. Conductor "blowout" (wind displacement) is considered under certain conditions (refer to Sections 7.9, 7.10 and 7.13).

7.1 GENERAL

7.11.10 PPL Clearance Criteria for Distribution Lines

A. Overhead distribution lines shall be designed to maintain adequate clearances under ice loaded conditions and the line's maximum conductor operating temperature (MCOT). In no case should a distribution line be designed for a MCOT below 120°F/48.9°C.

B. The required MCOT of the distribution line shall be determined by the appropriate planning department.

C. To protect conductors from damage caused by excessive heating, the required MCOT for the distribution shall not exceed the following limits:

   i. 176°F/80°C for primary bare conductors 35 kV and below,
   ii. 167°F/75°C primary covered conductors 35 kV and below,
   iii. 120°F/48.9°C for spacer cable messengers and 167°F/75°C for spacer cable phase conductors (Phase conductor temperatures higher than 120°F/50°C are taken to have no influence in elevating messenger temperatures),
   iv. Primary shielded and non-shielded aerial cables 35 kV and below shall be designed to operate with the messenger at 120°F/48.9°C ambient (Phase

conductor temperatures higher than 120°F/48.9°C are taken to have no influence in elevating messenger temperatures), and

v. Secondary non shielded cables 0 to 750 V shall be designed to operate with the messenger at 120°F/48.9°C ambient (Temperatures of the insulated conductors, lashed or twisted about the messenger, above 120°F/48.9°C, are taken to have no influence in elevating messenger temperatures).

D. New Installations and Extensions - Clearances for the installation of all new electric supply lines and extensions to existing lines shall be in accordance with the latest edition of the NESC and the requirements of any applicable state or local laws, rules or regulations.

E. Existing Installations - Where an existing installation meets, or is altered to meet, the current NESC Rules, such installation is considered to be in compliance with the current edition of the NESC and is not required to comply with any previous edition of the NESC.

F. Existing installations, including maintenance replacements, that currently comply with prior editions of the NESC, need not be modified to comply with these rules except as may be required for safety reasons by the administrative authority.

G. Where conductors or equipment are added, altered, or replaced on an existing structure, the structure or the facilities on the structure need not be modified or replaced if the resulting installation will be in compliance with either (a) the NESC rules that were in effect at the time of the original installation, (b) the rules in effect in a subsequent edition of the NESC to which the installation has been previously brought into compliance, or (c) rules in the latest edition of the NESC.

H. Clearances listed in the following STANDARDS and tables are considered minimum requirements for new construction. In some instances clearances exceeding those given may be required (e.g. when mandated by local ordinances). Other design considerations applying to Company work and operating practices may result in clearances greater than NESC minimum clearances. For example, vertical clearances for 34.5 kV grounded wye construction are based on pre-1987 codes, which called for 40 inch phase to neutral clearance at the pole and 30 inch phase to neutral clearance mid-span for spans up to 175 feet. These added clearances are deemed more prudent for hot-stick operation and maintenance of 25 kV and 35 kV constructions.

I. Effectively grounded circuits are defined as those circuits originating from a grounded-wye connected transformer or system, or from a system provided with a grounding transformer of sufficient size to stabilize the phase to ground voltage at approximately its normal value, regardless of whether the neutral conductor is present with the circuit. Circuits having a maximum X_0/X_1 ratio of 3.0 at the substation bus are considered effectively grounded circuits.

J. Voltage is the root-mean-square (rms) potential difference between any two conductors or between a conductor and ground. Voltages are expressed in nominal values unless otherwise indicated. Nominal voltage is the value assigned to a system or circuit of a given voltage class for the purpose of convenient designation. Operating voltage of the system may vary above or below the nominal voltage.

K. Voltages in the following tables are phase to ground, unless otherwise noted, for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. "Effectively grounded" means intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having

Supersedes 1/06 Issue – Fiber-optic cable information updated.

sufficient current-carrying capacity to limit the buildup of voltages to levels below that which may result in undue hazard to persons or to connected equipment. The voltage of a circuit not effectively grounded is the highest nominal voltage available between any two conductors on the circuit.

L. Clearance is defined as the clear distance between two objects measured surface to surface.

M. Spacing is defined as the distance between two objects measured center to center.

N. Clearances for tree wire, covered conductor, and spacer cable conductor are taken as if they were bare conductors.

O. Open conductors are defined as electric supply or communication construction in which the conductors are bare, covered or insulated and without grounded shielding, or individually supported at a structure either directly or with insulators.

P. Electric supply lines are those conductors used to transmit electric energy and their necessary supporting or containing equipment.

Q. Communication conductors include fire alarm, telephone, cable television, police alarm, data, telegraph, clock, and other systems used for communication service.

R. Fiber-Optic Cables in the supply space:

There are two general categories:

1. Fiber optic cables supported by an effectively ground metallic messenger.
2. All dielectric fiber optic (ADFO) cable.

Clearance requirements:

1. ADFO cables (i.e. meeting NESC Rule 230F1b) installed in the supply space have no specified clearances from supply conductors and other cables in the supply space.
2. Fiber optic cables supported by an effectively ground metallic messenger (i.e. meeting NESC Rule 230F1a) and ADFO cables (i.e. meeting NESC Rule 230F1b) are prohibited from being installed in the Communication Worker Safety Zone between the supply space and the communication space, but may be treated the same as effectively grounded neutrals for clearance purposes.

7.1.20 NESC Vertical Clearance Requirements Illustration – Rules 232 & 235

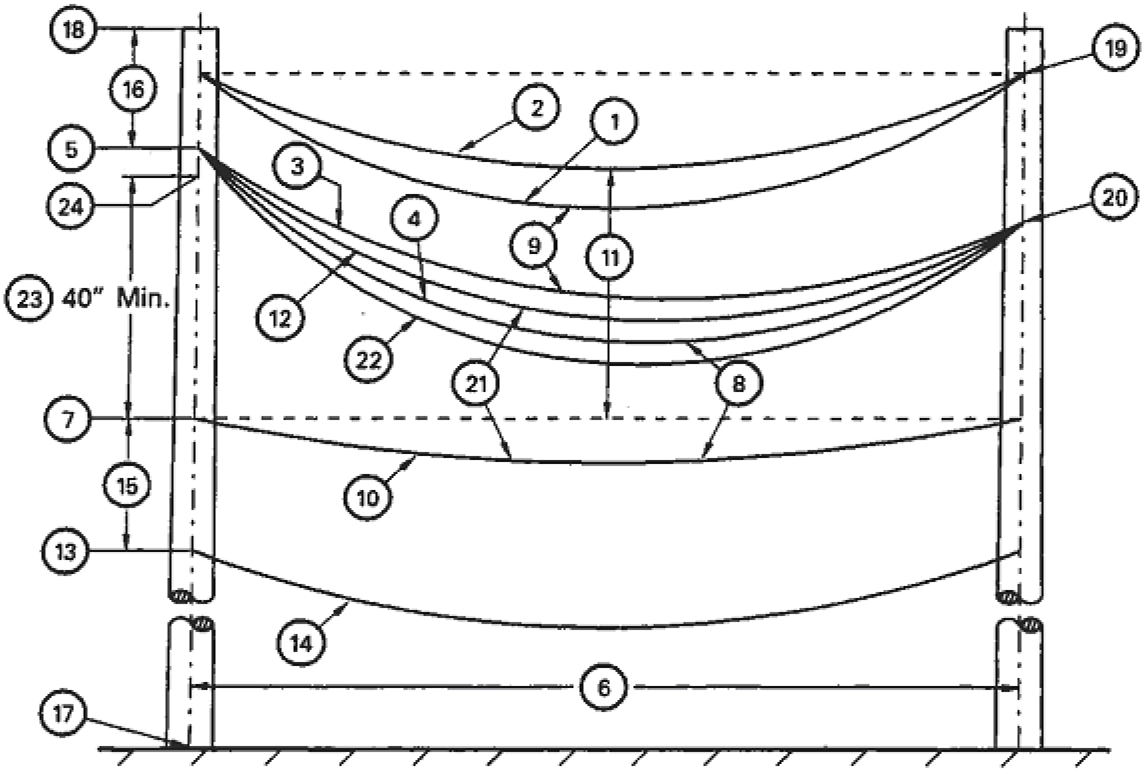


Figure 1

1 - Lowest upper supply conductor at position which produces maximum final sag; effectively grounded circuits 0-22 kV phase to ground.

2 - Lowest upper supply conductor at 60°F/15°C, final, unloaded sag; effectively grounded circuits 0-22 kV phase to ground

3 - Secondary cable, 0-750 V, supported by effectively grounded messenger; messenger at same operating ambient as 1 above.

4 - Effectively grounded neutral associated with 1 above.

5 - Lowest electrical point of attachment.

6 - Actual span length.

7 - Highest communication conductor attachment.

8 - May be reduced to 12 inches for effectively grounded neutral conductors, associated with circuits 0-22 kV phase to ground.

9 - Clearance in-span primary to secondary; must be 75% of that required at support, all span lengths.

10 - Highest communication conductor, Company design based on fire alarm pair or single telephone loop with midspan sag; 4 inches for 0 to 150 feet; 6 inches for 150 to 200 feet; 8 inches for 200 to 250 feet; and 12 inches for 250 to 300 feet; all ambients.

Supersedes 1/06 Issue – Editorial and paging revisions.

11 - For spans exceeding 150 feet, vertical clearances at the pole between the open supply conductors of over 750 V, but less than 50 kV, and the highest communication conductor, shall be adjusted, so that under conditions of both conductors at 60°F/15°C, no wind, and final unloaded sag, no point in the top supply conductor span shall be below a straight line joining the support points of the highest communication conductor.

12 - Secondary cable, 0-750 V, supported by effectively grounded messenger; at position which produces maximum final sag.

13 - Lowest communication conductor attachment.

14 - Lowest communication conductor.

15 - Communication conductor allocated space.

16 - Electric conductor allocated space.

17 - Final grade.

18 - Top of pole structure.

19 - Primary conductor attachment.

20 - Secondary cable or neutral attachment.

21 - Clearance in-span, secondary to top communication conductor; must be 75% of that required at support; all span lengths.

22 - Effectively grounded neutral conductor associated with top primary conductor; neutral at maximum sag condition.

23 - At pole clearance may be reduced to 30 inches from bottom of grounded non-current carrying equipment, such as transformers, capacitors and voltage regulators.

24 - Lowest electrical ownership.

Supersedes 1/06 Issue – Editorial and paging revisions.

7.2 RELATIVE LEVELS

Where supply lines of different voltages are attached to the same pole or cross one another, the higher voltage conductors should, where practical, be placed above those of lower voltage.

7.3 CLEARANCES OF SUPPORTING STRUCTURES FROM RAIL, CURB, HYDRANT & OTHER OBJECTS

Poles for overhead distribution lines shall be located with adequate clearance to railroad and automobile traffic. The following table demonstrates NESC minimum requirements. These requirements should be exceeded if practicable. State authorities prefer that poles be set back as far as possible from the pavement edge, behind guard rails, back of the ditch, behind sidewalks, curbs, etc. In any case, the approval of the authorities shall be obtained. Avoid poles at exposed corners and similar locations where they are likely to be struck by motor vehicles or snow removal equipment.

Table 1
Clearance of Supporting Structures from Rail, Curb or Hydrant
(Reference: NESC Rule 231)

Supporting structures[1], support arms, attached equipment, and braces shall have the following clearances (in feet) measured between the nearest parts of the objects concerned:

Objects	**Minimum (Ft.)**	**Recommended (Ft.)**
A. Fire Hydrants	3[2]	4[2]
B. Streets, Roads, Highways[3]	***Horizontal Clearance for First 15 Feet Above Ground***	
1. With street curbs (clearance measured from street side of the curb)		
a. Arterial Streets which are primarily for through traffic	0.5	2[4]
b. Local Streets which are primarily for access to residences, business or other abutting property	0.5	1[2]
2. With no curbs		See Note 5
C. All Railroad Tracks	***Horizontal Clearance for First 22 Feet Above the Nearest Track Rail***	
	12[6]	

FOOTNOTES:

1. Supporting structures are defined as the main supporting unit, usually a pole or tower.
2. This clearance also applies to anchor guys and push braces.
3. Where a governmental authority exercising jurisdiction over structure location has issued a permit for, or otherwise approved, specific locations for supporting structures, that permit or approval shall govern.
4. Place the supporting structures as far as practical behind the curb within the road right-of-way.
5. Place the supporting structures a sufficient distance from the roadway to avoid contact by ordinary vehicles using the traveled way.
6. This may be reduced to 7 feet where the supporting structure is not the controlling obstruction, provided sufficient space for a driveway is left where the cars are loaded and unloaded.

7.4 <u>VERTICAL CLEARANCES OF WIRES, CONDUCTORS, CABLES, AND EQUIPMENT ABOVE GROUND, ROADWAY, RAILS, ETC.</u>

Clearances for distribution conductors, found in Table 2, above ground, rails, etc., are based on a conductor temperature of 60°F/15°C, no wind.

i. 18 feet for: wires carrying less than 750 volts; guys, message wires, and communication cables; supply cables encases in a continuous metal sheath; and insulated supply cables fastened to an effectively grounded messenger cable,
ii. 20 feet for wires carrying more than 750 volts to 15,000 volts,
iii. 22 feet for wires carrying more than 15,000 volts to 50,000 volts, and
iv. 22 feet plus 4/10 inch for each 1,000 volt increase for wires carrying more than 50,000 volts.

Supersedes 1/06 Issue – Editorial and paging revisions.

Table 2
Minimum Vertical Clearance of Wires, Conductors, and Cables Above Ground, Roadways, or Rails
(Reference: NESC Table 232-1)

Column	Section Heading
1	Grounded guys; messengers, surge protection wires; grounded neutrals; shielded supply cables supported by grounded messenger; ungrounded guys exposed to 0- to 300 V[11,15;] and insulated communication cables and conductors
2A	Non-shielded supply cables, 0 to 750 V, supported by grounded messenger
2B	Non-insulated communication conductors
3	Open supply conductors 0 to 750 V; non-shielded supply cables supported by grounded messenger under 5 $kV_{ø-ø}$ or 2.9 $kV_{ø-G}$; ungrounded guys exposed to over 300 V to 750 V[14]
4	Open supply conductors over 750 V-22 kV; ungrounded guys exposed to 750 V to 22 kV[14]

Nature of Surface Underneath Wires, Conductors, or Cables	1 (ft.)	2A / 2B (ft.)	3 (ft.)	4 (ft.)
Where wires, conductors, or cables cross over or overhang				
1. Track rails of railroads (not using overhead electric supply conductors)[2,16]	23.5	24.0	24.5	26.5
2. Roads, streets, and other areas subject to truck traffic [3]	15.5	16.0	16.5	18.5
3. Driveways, parking lots, and alleys[23]	15.5[7,13]	16.0[7,13]	16.5 [7]	18.5
4. Land traversed by vehicles, such as cultivated, grazing, forest, orchards, etc.[26]	15.5	16.0	16.5	18.5
5. Spaces and ways subject to pedestrians or restricted traffic only[9]	9.5	12.0[8]	12.5[8]	14.5
Where Wires, Conductors Or Cables Run Along Highway Or Rights-Of-Way But Do Not Overhang The Roadway				
Nature of Surface Underneath Wires, Conductors, or Cables	**1 (ft.)**	**2A / 2B (ft.)**	**3 (ft.)**	**4 (ft.)**
6. Roads, streets, or alleys	15.5[24]	16.0	16.5	18.5
7. Roads in rural districts where it is unlikely that vehicles will be crossing under the line	13.5[10,12]	14.0[10]	14.5[10]	16.5

Note:

For voltages exceeding 22 kV, increase clearances specified above at a rate of 0.4 inches per kV in excess of 22 kV (reference NESC Rule 232C2a).

FOOTNOTES:

Note: Footnotes 1, 4-6, 17-22, and 25, are not used.

2. For wires, conductors, or cables crossing over mine, logging, or similar railways that handle only cars lower than standard freight cars, the clearance may be reduced by an amount equal to the difference in height between the highest loaded car handled and 20 feet, but the clearance shall not be reduced below that required for street crossings

3. Does not include neutral conductors effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1).

7. Where vehicles exceeding 8’ in height are not normally encountered nor reasonably anticipated, service drop(s) clearances over residential driveways only may be reduced to the following:

	Feet
Insulated supply service drops limited to 300 V to ground	12.5
Insulated drip loops of supply service drops limited to 300 V to ground	10.5
Supply service drops limited to 150 V to ground that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C3)	12.0
Drip loops only of service drops limited to 150 V to ground that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C2 or 230C3)	10.0
Insulated communication service drops	11.5

8. These clearance values for service drops to residential buildings only may be reduced to the following:

	Feet
Insulated supply service drops limited to 300 V to ground	10.5
Insulated drip loops of supply service drops limited to 300 V to ground	10.5
Supply service drops limited to 150 V to ground that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C3)	10.0
Drip loops only of service drops limited to 150 V to ground that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C1 or 230C3)	10.0

9. Spaces and ways subject to pedestrians or restricted traffic only are those where riders on horseback or other large animals, vehicles, or other mobile units exceeding 8 feet in height, are prohibited by regulation or permanent terrain configurations or are otherwise not normally encountered nor reasonably anticipated.

10. Where a supply or communication line along a road is located relative to fences, ditches, embankments, etc., so that ground under the line would not be expected to be traveled except by pedestrians, the clearances may be reduced to the following values:

	Feet
Insulated communication conductor and communication cables	9.5
Conductors of other communication circuits	9.5
Lashed aerial cables (insulated and fully metallic shielded) installed according to these standards and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C1), supply cables limited to 150 V to ground that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C2 or 230C3), and neutral conductors that are effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1)	9.5
Insulated supply conductors limited to 300 V to ground	12.5
Guys	9.5

11. No clearance from ground is required for anchor guys not crossing tracks, rails, streets, driveways, roads, or pathways.

12. This clearance may be reduced to 13 feet for communication conductors and guys.

13. Where this construction crosses over or runs along alleys, driveways, or parking lots not subject to truck traffic, this clearance may be reduced to 15 feet.

Supersedes 7/08 Issue – Revised Footnotes 7 and 8 to reflect 2017 NESC revisions.

14. Ungrounded guys and ungrounded portions of span guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed due to slack conductor or guy.

15. Anchor guys insulated in accordance with these standards may have the same clearance as grounded guys.

16. Adjacent to tunnels and overhead bridges that restrict the height of loaded rail cats to less than 20 feet, if mutually agreed to by the parties at interest.

23. For the purpose of this Rule, trucks are defined as any vehicle exceeding 8 feet in height. Areas not subject to truck traffic are areas where truck traffic is not normally encountered nor reasonably anticipated.

24. Communication cables and conductors may have a clearance of 15 feet where poles are in back of curbs or other deterrents to vehicular traffic.

26. When designing a line to accommodate oversized vehicles, these clearance values shall be increased by the difference between the known height of the oversized vehicle and 14 feet.

7.5 VERTICAL CLEARANCE OF WIRES, CONDUCTORS AND CABLES ABOVE WATER SURFACES

Vertical clearances of distribution supply wires and conductors over waterways shall not be less than those shown on Table 3: Vertical Clearance Above Water Surfaces. Where the U.S. Army Corps of Engineers has issued a crossing permit, clearances of that permit shall govern, if greater.

Table 3
Vertical Clearance Above Water Surface (Reference: NESC Table 232-1)

Column	Section Heading
1	Insulated communication conductors and cable; messengers; surge-protection wires; grounded guys; ungrounded guys exposed to 0 to 300 V[11,15]
2	Non-insulated communication conductors; and non-shielded supply cables 0 to 750 V supported by grounded messenger
3	Open supply conductors 0 to 750 V; non-shielded supply cables supported by grounded messenger under 5 $kV_{\Phi-\Phi}$ or 2.9 $kV_{\Phi-G}$; ungrounded guys exposed to over 300 V to 750 V[14]
4	Open supply conductors over 750 V to 22 kV; ungrounded guys exposed to 750 V to 22 kV[14]

Nature of Surface Underneath Wires, Conductors, or Cables	1 (ft.)	2 (ft.)	3 (ft.)	4 (ft.)
Where wires, conductors, or cables cross over or overhang				
1. Water areas not suitable for sailboating or where sailboating is prohibited[21]	14.0	14.5	15.0	17.0
2. Water areas suitable for sailboating including lakes, ponds, reservoirs, tidal waters, rivers, streams, and canals with an unobstructed surface area of: [17,18,19,20,21]				
a. Less than 20 acres	17.5	18.0	18.5	20.5
b. Over 20 to 200 acres	25.5	26.0	26.5	28.5
c. Over 200 to 2000 acres	31.5	32.0	32.5	34.5
d. Over 2000 acres	37.5	38.0	38.5	40.5

Notes:

(a) Clearances may be reduced under certain conditions. See NESC Rule 232.

FOOTNOTES:

Note: Footnotes 1-10, 12, 13, and 16 will not be used.

11. No clearance from ground is required for anchor guys not crossing tracks, rails, streets, driveways, roads, or pathways.

14. Ungrounded guys and ungrounded portions of span guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed due to a slack conductor or guy.

15. Anchor guys insulated in accordance with these standards may have the same clearance as grounded guys.

17. For controlled impoundments, the surface area and corresponding clearances shall be based upon the design high-water level.

18. For uncontrolled water flow areas, the surface area shall be that enclosed by its annual high-water mark. Clearances shall be based on the normal flood level; if available, the 10-year flood level may be assumed as the normal flood level.

19. The clearance over rivers, streams, and canals shall be based upon the largest surface area of any 1 mile long segment that includes the crossing. The clearance over a canal, river, or stream normally used to provide access for sailboats to a larger body of water shall be the same as that required for the larger body of water.

20. Where an over-water obstruction restricts vessel height to less than the applicable reference height given in NESC Table 232-3, the required clearance may be reduced by the difference between the reference height and the over-water obstruction height, except that the reduced clearance shall not be less than that required for the surface area on the line crossing side of the obstruction.

7.6 CLEARANCE TO SWIMMING POOLS

Service drops or other supply wires and conductors should not pass over a swimming pool or the surrounding land within 25 feet around the edge of the pool. If such crossings cannot be avoided, the clearances shown below shall be obtained. For all spans, horizontal clearances must be increased as shown on Page 7-124. For information on other requirements and relocation policy refer to Specifications for Electrical Installations (ESB 750).

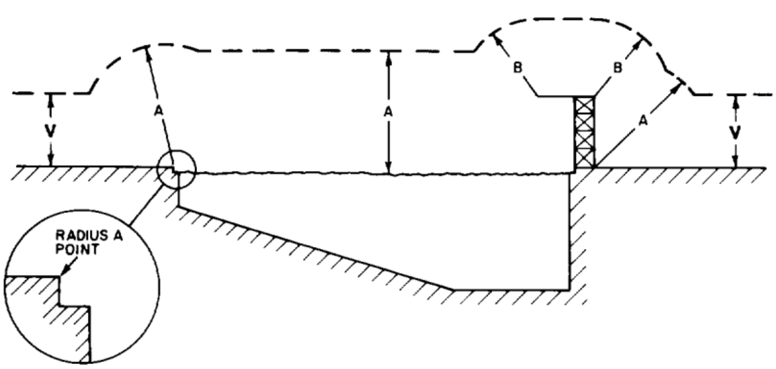


Figure 3

Table 4
Clearance to Swimming Pools
(Reference: NESC Table 234-3, Figure 234-3, Rules 232 and 234)

Column	Section Heading
1	Insulated communication conductors and cables; messengers; surge-protection wires; grounded guys; ungrounded guys exposed to 0-300 V[3]; neutral conductors that are effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1); lashed aerial cables (insulated and fully metallic shielded) installed according to these standards and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C1)
2	Unguarded rigid live parts, 0 to 750 V; non-insulated communication conductors; supply cables of 0 to 750 V that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C2 or 230C3); ungrounded guys exposed to open supply conductors of over 300 V to 750 V[2]
3	Supply cables over 750 V and under 5 kV phase-to-phase or 2.9 kV phase-to-ground that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C2 or 230C3); open supply conductors, 0 to 750 V
4	Unguarded rigid live parts over 750 V to 22 kV; ungrounded guys exposed to over 750 V to 22 kV[2]
5	Open supply conductors, over 750 V to 22 kV

	Column 1 (ft)[7]	Column 2 (ft)[8]	Column 3 (ft)	Column 4 (ft)	Column 5 (ft)
A. Clearance in any direction from the water level, edge of pool, base of diving platform, or anchored raft	22.0	22.5	23.0	24.5	25.0
B. Clearance in any direction to the diving platform, tower, water slide or other fixed pool-related structures	14.0	14.5	15.0	16.5	17.0
V. Vertical clearance to adjacent land	*Clearances specified in Section 7.4*				

Supersedes 7/08 Issue – Replaced footnote 7. Added footnote 8.

FOOTNOTES:

1. For voltages over 22 kV and up to 50 kV increase specified clearance at a rate of 0.4 inches per kV over 22 kV.

2. Ungrounded guys and ungrounded portions of guys between insulators shall have clearances based on the highest voltage to which they may be exposed due to a slack conductor or guy.

3. Anchor guys insulated in accordance with these standards may have the same clearance as grounded guys.

4. Where wires, conductors, cables, or unguarded rigid live parts are over a swimming pool or the surrounding area, clearances in any direction shall be as shown in the Figure 3 and Table 4 on Page 7-10. This rule does not apply to a pool enclosed by a solid or screened permanent structure.

5. If rescue poles are not used by lifeguards on supervised beaches and waterways, the clearances in Table 3 on Page 7-8 for appropriate land/water body shall be used.

6. Use clearances in Table 3 on Page 7-8 for waterways subject to waterskiing.

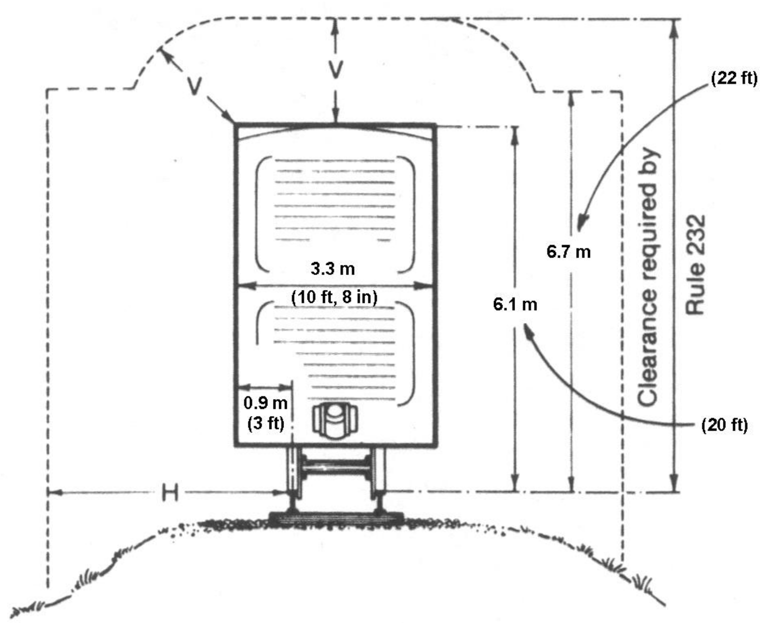
7. These clearance requirements do not apply when these facilities are 10 ft or more horizontally from the edge of the pool, diving platform, diving tower, water slide, or other fixed, pool-related structures.

8. These clearance requirements do not apply for non-insulated communication conductors; supply cables of 0 to 750 V that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C2 or 230C3); ungrounded guys exposed to open supply conductors of over 300 V to 750 V when these facilities are installed 10 ft or more horizontally from the edge of the pool, diving platform, diving tower, water slide, or other fixed, pool-related structures.

9. Use clearances in Table 3 on Page 7-8 for waterways subject to waterskiing.

7.7 VERTICAL & HORIZONTAL CLEARANCE OF WIRES, CONDUCTORS AND CABLES TO RAIL CARS

(Reference: NESC Rules 232, 234-1, 234I, Table 232-1, and Figure 234-5)



V = Vertical clearance above rails specified by Section 7.4 of these standards, minus 20 feet (height of rail car)
H = Horizontal clearance to nearest rail.

Overhead Wires, Conductors Or Cables	Clearance In Feet	
	V	H
Grounded Guys, Messengers, Surge Protection Wires, Grounded Neutrals, Shielded Supply Cables Supported By Grounded Messenger, Ungrounded Guys exposed to 0 to 300 V[(e)] And Insulated Communication Cables And Conductors	3.5	8.5
Non-shielded Supply Cables, 0 to 750 V, Supported By Grounded Messenger, Non-insulated Communication Conductors	4.0	9.0
Open Supply Conductors, 0 to 750 V, Non-shielded Supply Cables Supported By Grounded Messenger, Under 5 $kV_{\Phi-\Phi}$, or 2.9 $kV_{\Phi-g}$, Ungrounded Guys Exposed To Over 300 V to 750 V[(f)]	4.5	9.5
Open Supply Conductors Over 750 V to 22 kV; Ungrounded Guys Exposed To 750 V to 22 kV[(f)]	6.5	11.5

Supersedes 7/08 Issue – Modified footnote 7. Added footnote 8.

Notes:

(a) If the Railroad crossed requires greater clearances than detailed in this Standard, the Railroad clearances shall apply.

(b) Voltages are phase to ground for grounded circuits and those circuits where ground faults are cleared promptly by de-energizing the faulted section. For systems that are not effectively grounded, voltages are phase-to-phase.

(c) Anchor guys shall not be located less than 12 feet from the nearest track rail.

(d) Anchor guys insulated in accordance with these standards may have the same clearance as grounded guys.

(e) Ungrounded guys and ungrounded portions of span guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed due to slack conductor or guy.

Supersedes 1/06 Issue – Editorial and paging revisions.

7.8 VERTICAL CLEARANCE OF EQUIPMENT CASES AND RIGID LIVE PARTS OF EQUIPMENT MOUNTED ON STRUCTURES

Table 5
(Reference: NESC Rule 232B, Table 232-2)

Note - These vertical clearances above ground or roadway surfaces are for unguarded rigid live parts such as potheads, transformer bushings, surge arresters, and short lengths of connecting supply conductors which are not subject to variations in sag.

Column	Section Heading
1	Nonmetallic or effectively grounded support arms, switch handles, platforms, braces, and equipment cases
2	Unguarded rigid live parts of 0 to 750 V and ungrounded cases that contain equipment connected to circuits of not more than 750 V
3	Unguarded rigid live parts of over 750 V to 22 kV and ungrounded cases that contain equipment connected to circuits of over 750 V to 22 kV

Nature of Surface Below	Clearance Above Ground or Roadway		
	Column 1 (ft.)	Column 2 (ft.)	Column 3 (ft.)
1. Where rigid parts overhang:			
a. Roads, streets and other areas subject to truck traffic[4]	15.0	16.0	18.0
b. Driveways, parking lots and alleys	15.0	16.0[6]	18.0
c. Other land traversed by vehicles such as cultivated land, grazing land, forest, orchard, etc.	15.0[7]	16.0	18.0
d. Spaces and ways subject to pedestrians or restricted traffic only[5]	11.0[7]	12.0[1(b)]	14.0
2. Where rigid parts are along and within the limits of highways or other road rights-of-way but do not overhang the roadway			
a. Roads, streets and alleys	15.0[7]	16.0	18.0
b. Roads in rural districts where it is unlikely that vehicles will be crossing under the line	13.0[7]	14.0[2]	16.0

3. Water areas not suitable for sailboating or where sailboating in prohibited[9]	14.0	14.5	15.0

FOOTNOTES:

<u>Note:</u> Footnotes 3, 6, and 8 will not be used.

1. For insulated live parts limited to 150 V, this clearance may be reduced to 10 ft.

2. Where a supply line along a road is limited to 300 V to ground and is located relative to fences, ditches, embankments, etc., so that the ground under the line would not be expected to be traveled except by pedestrians, this clearance may be reduced to 12 feet.

4. For the purpose of this rule, trucks are defined as any vehicle exceeding 8 feet in height. Areas not subject to truck traffic are areas where truck traffic is not normally encountered nor reasonably anticipated.

5. Spaces and ways subject to pedestrians or restricted traffic only are those areas where riders on horseback or other large animals, vehicles or other mobile units exceeding 8 feet in height, are prohibited by regulation or permanent terrain configurations or are otherwise not normally encountered nor reasonably anticipated.

6. This clearance may be reduced to the following values for driveways, parking lots, and alleys not subject to truck traffic:

	(ft)
a. Insulated live parts limited to 300 V to ground	12
b. Insulated live parts limited to 150 V to ground	10

7. Effectively grounded switch handles and supply or communication equipment cases (such as fire alarm boxes, control boxes, communication terminals, meters, or similar equipment cases) may be mounted at a lower level for accessibility provided such cases do not unduly obstruct a walkway. Switch handles and supply or communications shall be located so as not to serve as a means of approach to unguarded live parts by unqualified persons.

9. Where the US Army Corps of Engineers, the state, or surrogate thereof has issued a crossing permit, clearance of that permit shall govern.

Supersedes 1/06 Issue – Added FN 6, added switch handles in FN 7.

7.9 <u>CLEARANCE OF WIRES, CONDUCTORS, CABLES AND UNGUARDED LIVE PARTS TO BUILDINGS & OTHER INSTALLATIONS EXCEPT BRIDGES</u>

Primary wires should not be installed over buildings. There are cases, however, especially for temporary work, where such construction cannot be avoided. The clearance of 300 V to 15,000 volt lines over or near buildings and appurtenances shall be as much as is practicable. In no case should it be less than shown below. Services may however, be attached to or run along, or over the building in accordance with accepted practices.

Minimum clearances for multiplex conductors attached to buildings are shown below as well.

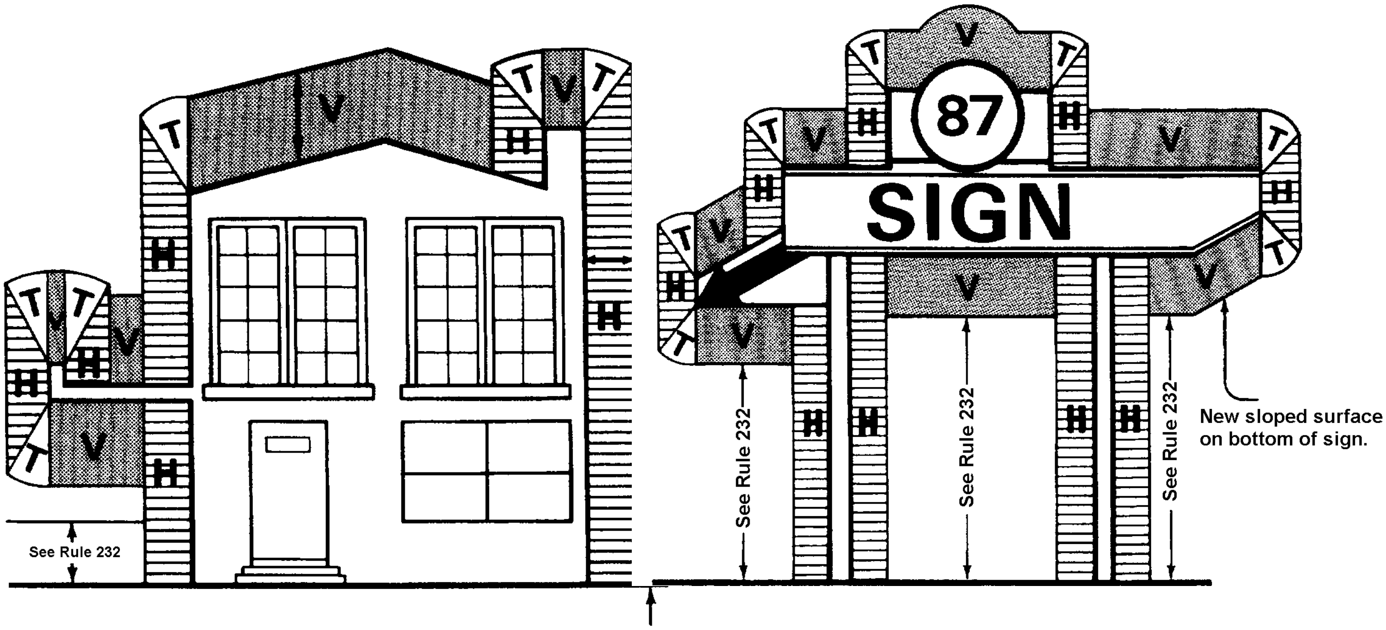


Figure 5

Regions Where Conductors Are Prohibited:
H = Horizontal; V = Vertical; T = Transitional = Vertical (Arc)

Table 6
Clearance of Wires, Conductors, Cables and Unguarded Live Parts to Buildings & Other Installations Except Bridges

(Reference: NESC Tables 234-1 and Rules 232 and 234)

Column	Section Heading
1	Grounded guys, messengers; surge protection wires; grounded neutrals; shielded supply cables supported by grounded messenger; ungrounded guys exposed to 0 to 300 V[13]; and insulated communication cables and conductors
2	Non-shielded supply cables 0 to 750 V, supported by grounded messenger
3	Unguarded rigid live parts 0 to 750 V; ungrounded equipment cases, 0-750 V; ungrounded guys exposed to open supply conductors of over 300 to 750 V[5], and non-insulated communication conductors
4	Open supply conductors 0-750 V; non-shielded supply cables supported by a grounded messenger, over 750 V and under 5 $kV_{\Phi-\Phi}$ or 2.9 $kV_{\Phi-G}$[18]
5	Unguarded rigid live parts, over 750 V-22 kV; ungrounded equipment cases, 750 V–22 kV; ungrounded guys exposed to over 750 V to 22 kV[5]
6	Open supply conductors, over 750 V to 22 kV

Supersedes 1/06 Issue – Editorial and paging revisions.

Clearance of:	1 (Feet)	2 (Feet)	3 (Feet)	4 (Feet)	5 (Feet)	6 (Feet)
1. Buildings						
a. Horizontal						
(1) To walls, projections, and guarded windows	4.5[2,7]	5.0[2]	5.0[2]	5.5[2,9]	7.0[2]	7.5[2,10,11]
(2) To unguarded windows[8]	4.5	5.0	5.0	5.5[9]	7.0	7.5[10,11]
(3) To balconies and areas readily accessible to peedestrieans[3]	4.5	5.0	5.0	5.5[9]	7.0	7.5[10,11]
b. Vertical						
(1) Over/under roofs or projections not readily accessible to pedestrians	3.0	3.5	10.0	10.5	12.0	12.5
(2) Over/under balconies and roofs readily accessible to pedestrians[3]	10.5	11.0	11.0	11.5	13.0	13.5
(3) Over roofs accessible to vehicles but not subject to truck traffic[6]	10.5	11.0	11.0	11.5	13.0	13.5
(4) Over roofs accessible to truck traffic[6]	15.5	16.0	16.0	16.5	18.0	18.5
2. Signs, chimneys, billboards, radio and TV antennas, tanks, and other installations not classified as buildings or bridges						
a. Horizontal[4]						
(1) To portions that are readily accessible to pedestrians[3]	4.5	5.0	5.0[2]	5.5[9]	7.0[2]	7.5[10,11]
(2) To portions that are not readily accessible to pedestrians[3]	3.0	3.5	5.0[1,2]	5.5[2,9]	7.0[2]	7.5[2,10,11]
b. Vertical						
(1) Over/under catwalks and other surfaces upon which personnel walk	10.5	11.0	11.0	11.5	13.0	13.5
(2) Over/under other portions of such installations[4]	3.0	3.5	5.5	6.0	7.5	8.0
3. Clearance from other supporting structures[15]						
a. Horizontal (no wind)	5.0 [16]	5.0 [16]	5.0 [16]	5.0 [16]		5.0 [16]
b. Vertical	4.5 [17]	4.5 [17]	4.5 [17]	4.5 [17]		4.5 [17]

FOOTNOTES:

Footnotes 1 and 12 are not used

2. Where available space may not permit this value, the clearance may be reduced by 2 feet provided the wires, conductors, or cables, including splices and taps, and unguarded live parts have a covering that provides sufficient dielectric strength to limit the likelihood of a short circuit in case of momentary contact with a structure or building.

3. A roof, balcony, or area is considered readily accessible to pedestrians if it can be casually accessed through a doorway, ramp, window, stairway, or permanently mounted ladder by a person on foot who neither exerts extraordinary physical effort nor employs tools or devices to gain entry. A permanently mounted ladder is not considered a means of access if its bottom rung is 8 feet or more from the ground or other permanently installed accessible surface.

Supersedes 7/08 Issue – Deleted Footnote 1 and references to it to reflect 2017 NESC revisions.

Supersedes 17/08 Issue – Revised FN7 to require guys to be effectively grounded, not just grounded, to allow reduced clearances.

4. The required clearances shall be to the closest approach of motorized signs or moving portions of installations (reference NESC rule 234C).

5. Ungrounded guys and ungrounded portion of guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed to a slack conductor or guy.

6. For purpose of this rule, trucks are defined as any vehicle exceeding 8 feet in height.

7. This clearance may be reduced to 3 inches for the effectively grounded portions of guys.

8. Windows not designed to open may have the clearances permitted for walls and projections.

9. The clearance at rest shall be not less than the value shown in this table. Also, when the conductor or cable is displaced by wind, the clearance shall be not less than 4.5 feet (reference NESC Rule 234C1b).

10. The clearance at rest shall be not less than the value shown in this table. Also, when the conductor or cable is displaced by wind, the clearance shall be not less than 4.5 feet (reference NESC Rule 234C1b).

11. Where available space will not permit this value, the clearance may be reduced to 7 feet for conductors limited to 8.7 kV to ground.

13. The anchor end of guys insulated in accordance with these standards may have the same clearance as grounded guys.

14. For clearances above railings, walls, or parapets around balconies or roofs, use the clearances required for roofs not accessible to pedestrians.

15. Support structures include those to which the conductor is not attached, such as lighting support, a traffic signal support, and a supporting structure of another line.

16. This may be reduced to 3 feet for effectively grounded guys and messengers, insulated communication conductors and cables, neutral conductors that are effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1), and supply cables of 300 V or less that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C1, 230C2 or 230C3).

17. This may be reduced to 2 feet for effectively grounded guys and messengers, insulated communication conductors and cables, neutral conductors that are effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1), and supply cables of 300 V or less that are insulated and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C1, 230C2 or 230C3).

18. Does not include neutral conductors effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1).

Note:

For horizontal clearances under wind displacement conditions, reference the table found in 7.10 corresponding to minimal clearance values. Sample calculations for accounting for wind displacement can be referenced on Page 7-124.

7.10 CLEARANCE TO BRIDGES

The clearance of distribution conductors and cables to bridges shall not be less than those shown in Table 7 below. These are minimum values that should be increased wherever practicable. The clearance over pedestrian walks or over roadways on bridges shall meet the requirements of Table 2 on Page 7-6.

For all spans, horizontal clearances must be increased as shown on Page 7-124.

Under wind displacement conditions, the following conductors and cables shall be in accordance with the below specified horizontal clearances to bridges. Sample calculations for increased clearances due to wind displacement can be referenced on Page 7-124.

Table 7
Horizontal Clearances Under Wind Displacement Conditions[2]
(Reference: NESC Rule 234D1b)

Conductor of Cable	Horizontal Clearance Required when Displaced by Wind (Feet)
Open Supply Conductor, 0 to 750 V[1]	3.5
230C2 Cable, Above 750 V	3.5
230C3 Cable, Above 750 V	3.5
Open Supply Conductor, over 750 V to 22 kV	4.5

FOOTNOTES:

1. Does not include neutral conductors effectively grounded throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1).
2. See Table 8 for clearances for conductors and cables at rest (not displaced by wind).

Table 8
Clearance of Wires, Conductors, Cables, and Unguarded Rigid Live Parts from Bridges
(Reference: NESC Table 234–2 and Rule 234D1a)

Column	Section Heading
1	Unguarded rigid live parts, 0 to 750 V; non-insulated communication conductors; supply cables of 0 to 750 V meeting Rules 230C2 or 230C3[7]; ungrounded equipment cases; 0 to 750 V; ungrounded guys exposed to open supply conductors over 300 V to 750 V[4]
2	Supply cables over 750 V meeting Rules 230C2 or 230C3[7]; open supply conductors, 0 to 750 V[10]
3	Open supply conductors, over 750 V to 22 kV
4	Unguarded rigid live parts, over 750 V to 22 kV; ungrounded equipment cases, 750 V to 22 kV; ungrounded guys exposed to open supply conductors of over 750 V to 22 kV[4]

	Column 1 (Feet)	Column 2 (Feet)	Column 3 (Feet)	Column 4 (Feet)
1. Clearance over bridges[1]				
a. Attached[3]	3.0	3.5	5.5	5.0
b. Not Attached	10.0	10.5	12.5	12.0
2. Clearance beside, under, or within bridge structure[6]				
a. Readily accessible portions of any bridge including wing, walls, and bridge attachments[1]				
(1) Attached[3]	3.0	3.5[8]	5.5[9]	5.0
(2) Not Attached	5.0	5.5[8]	7.5[9]	7.0
b. Ordinarily inaccessible portions of bridges (other than brick, concrete, or masonry) and from abutments[2]				
(1) Attached[3,5]	3.0	3.5[8]	5.5[9]	5.0
(2) Not Attached[4,5]	4.0	4.5[8]	6.5[9]	6.0

Supersedes 1/06 Issue – Added FNs 1 and 2.

Supersedes 7/08 Issue – Corrected page reference in 7.11.10.

FOOTNOTES:

1. Where over traveled ways on or near bridges, the clearances of Section 7.4 also apply.

2. Bridge seats of steel bridges carried on masonry, brick, or concrete abutments that require frequent access for inspection shall be considered as readily accessible portions.

3. Clearance from supply conductors to supporting arms and brackets attached to bridges shall be the same as specified in Section 7.14 if the supporting arms and brackets are owned, operated, or maintained by the same utility.

4. Ungrounded guys and ungrounded portions of guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed due to a slack conductor or guy.

5. Where conductors passing under bridges are adequately guarded against contact by unauthorized persons and can be de-energized and appropriately grounded on each side of the work location for maintenance of the bridge, clearances of the conductors from the bridge, at any point, may have the clearances specified in Section 7.14 for clearance from surfaces of support arms plus one-half the final unloaded sag of the conductor at that point.

6. Where the bridge has moving parts, such as a lift bridge, the required clearances shall be maintained throughout the full range of movement of the bridge or any attachment thereto.

7. Where permitted by the bridge owner, supply cables may be run in rigid conduit attached directly to the bridge.

8. The clearance at rest shall not be less than the value shown in this Table. Also, when the conductor or cable is displaced by wind, the clearance shall be not less than 3.5 feet (reference NESC Rule 234D1b).

9. The clearance at rest shall be not less than the value shown in this Table. Also, when the conductor or cable is displaced by wind, the clearance shall be not less than 4.5 feet (reference NESC Rule 234D1b).

10. Does not include neutral conductors effectively grounded throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1).

7.11 SEPARATION OF CONDUCTORS AND SUPPORTS ON THE SAME POLE

7.11.10 General

Minimum recommended separations between supports and conductors on the same pole are shown in Table 9 on Page 7-20. These should be used on all poles for new lines. They shall generally be used for pole replacements. These should be used only when values recommended for new poles per the Drawings demonstrated in Section 9 - Primaries, are not practicable. As these values are suggesting minimum guidelines, clearances shall be increased to provide additional safety protection wherever possible.

Table 9
Vertical Clearance Between Conductors at Supports
(Reference: NESC Rules 235A, C and Table 235-5)

Column	Section Heading
1	Lashed aerial cables (insulated and fully metallic shielded) installed according to these standards and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C1); insulated, nonshielded cable operated at not over 5 kV phase to phase, or 2.9 kV phase to ground, supported on and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C3); neutral conductors that are effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1); and insulated communication cables, located in the supply space, supported by an effectively grounded messenger (i.e. meeting NESC Rule 224A2)
2	Open supply conductors, 0 to 8.7 kV[12]
3	Open supply conductors, over 8.7 kV to 50 kV, same utility[8]
4	Open supply conductors, over 8.7 kV to 50 kV, different utilities[8]

Conductors and Cables Usually at Lower Levels	Conductors and Cables Usually At Upper Levels							
	Column 1 (Inches)		Column 2[12] (Inches)		Column 3[8] (Inches)		Column 4[8] (Inches)	
	At Pole	Mid-Span	At Pole	Mid-Span	At Pole	Mid-Span	At Pole	Mid-Span
1. Communication Conductors and Cables								
a. Located in the communication space	40[1,5,6]	30[12]	40	30[13]	40	30	40+A[7]	See Note 15
b. Located in the supply space	16[9,10]	12	16[10]	12	40[10]	30	40+A[7]	See Note 15
2. Supply conductors and cables								
a. Open conductors 0 to 750 V; lashed aerial cables (insulated and fully metallic shielded) installed according to these standards and cabled together with an effectively grounded bare messenger or neutral; insulated, nonshielded cable operated at not over 5 kV phase to phase, or 2.9 kV phase to ground, supported on and cabled together with an effectively grounded bare messenger or neutral; and neutral conductors that are effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1)	16[9]	12	16[2]	12[14]	16+A[4,7]	See Note 15	40+A[7]	See Note 15
b. Open conductors over 750 V to 8.7 kV			16[2]	12	16+A[4,7]	See Note 15	40+A[7]	See Note 15
c. Open conductors over 8.7 to 22 kV								
(1) If worked on alive with live-line tools and adjacent circuits are neither de-energized nor covered with shields or protectors					16+A[7]	See Note 15	40+A[7]	See Note 15
(2) If not worked on alive except when adjacent circuits (either above or below) are de-energized or covered by shields or protectors, or by use of live-line tools not requiring line workers to go between live wires					16+A[3,7]	See Note 15	40+A[3,7]	See Note 15
d. Open conductors exceeding 22 kV , but not exceeding 50 kV					16+A[3,7]	See Note 15	40+A[3,7]	See Note 15

A = 0.4 inches per kV in excess of 8.7 kV

When using column and row headings, voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations.

Supersedes 7/08 Issue – Added new FN 6 & renumbered FNs 6 & 7.

FOOTNOTES:

1. Where supply circuits of 600 V or less, with transmitted power of 5,000 W or less, are run below communication circuits, the clearance may be reduced to 16 inches. This type of installation must be built following special requirements of NESC Rule 220B2. Distribution Standards Engineering should be consulted prior to making an installation of this type.

2. Where conductors are operated by different utilities, a vertical clearance of not less than 40 inches is recommended.

3. These values do not apply to conductors of the same circuit or circuits being carried on adjacent conductor supports.

4. May be reduced to 16 inches where conductors are not worked on live except when adjacent circuits (either above or below) are de-energized or covered by shields or protectors, or by the use of live line tools not requiring line workers to go between live wires.

5. May be reduced to 30 inches for neutral conductors effectively grounded throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1); fiber-optic cables installed in the supply space supported on a messenger that is effectively grounded throughout its length (i.e. meeting NESC Rule 230F1a); and entirely dielectric fiber-optic cables or fiber-optic cables supported on a messenger that is entirely dielectric and installed in the supply space (i.e. meeting NESC Rule 230F1b). Bonding is not required for entirely dielectric fiber-optic cables or fiber-optic cables supported on a messenger that is entirely dielectric and installed in the supply space (i.e. meeting NESC Rule 230F1b).

6. May be reduced to 30 inches for lashed aerial cables that are insulated, shielded and installed according to these standards where the supply neutral or messenger is bonded to the communication messenger (i.e. meeting NESC Rule 230C1), except that in accordance with the PPL settlement agreement with Verizon, Verizon requires PPL to maintain 40" clearance at the pole between lashed aerial cables and Verizon owned communication cables. Application of this exception for lashed aerial cables shall require approval from Overhead Distribution Standards.

7. The greater of phasor difference or phase-to-ground voltage (for more information see NESC Rule 235A3).

8. Example: For a 50 kV-to-ground conductor above a 22 kV-to-ground conductor, when the conductors are 180 degrees out of phase: A = (50 + 22 - 8.7) * 0.4 = 25.4 inches, then round A up to 26 inches.

9. No clearance is specified between neutral conductors effectively grounded throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1) and insulated communication cables located in the supply space and supported by an effectively grounded messenger (i.e. meeting NESC Rule 230F1a).

10. No clearance is specified between entirely dielectric fiber-optic cables or fiber-optic cables supported on a messenger that is entirely dielectric and installed in the supply space (i.e. meeting NESC Rule 230F1a) and supply cables and conductors.

11. Does not include neutral conductors effectively ground throughout their length and associated with circuits of 0 to 22 kV phase to ground.

Supersedes 7/08 Issue – Revised FN 5, added new FN 6 & renumbered FNs 6 & 7.

12. May be reduced to 12 inches for neutral conductors effectively grounded throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1); fiber-optic cables installed in the supply space supported on a messenger that is effectively grounded throughout its length (i.e. meeting NESC Rule 230F1a); entirely dielectric fiber-optic cables or fiber-optic cables supported on a messenger that is entirely dielectric and installed in the supply space (i.e. meeting NESC Rule 230F1b); and lashed aerial cables installed according to these standards where the supply neutral or messenger is bonded to the communication messenger (i.e. meeting NESC Rule 230C1). Bonding is not required for entirely dielectric fiber-optic cables or fiber-optic cables supported on a messenger that is entirely dielectric and installed in the supply space (i.e. meeting NESC Rule 230F1b).

13. Supply service drops of 0 to 750 volts, running above and parallel to communication service drops, may have a spacing of not less than 12 inches at any point in the span, including the point of their attachment to the building or structure being served provided the non-grounded conductors are insulated and that clearance as otherwise required by these standards is maintained between the two service drops at the pole.

14. Where conductors are operated by different utilities, a vertical clearance of not less than 30 inches is recommended.

15. 75% of clearance required at the pole.

7.11.20 Separation on Replaced Poles

In general, the separations on poles that are replaced shall conform to the requirements for new poles. In some special cases, separation may be reduced, but shall not be less than permitted on existing poles.

7.11.30 Reduction of Separation on Poles

Reduced separations of conductors and facilities may be used to accommodate other pole users but shall not be less than clearances required for 15 kV primary circuits.

7.11.40 Basic Impulse Level (BIL) & Air – Wood Spacing

BIL refers to the ability of the pole top design to resist flashovers caused by lightning or line surges.

Distribution pole tops are generally designed to provide 150 kV minimum BIL. This impulse strength shall be based entirely on the impulse flashover of 20 inches or more of wood. Where lightning arresters are used, the “inches of wood” requirement does not apply for the particular conductor having the arrester. In locations where sufficient wood separation is not obtainable due to guy attachment, the use of a fiberglass guy strain insulator will meet this requirement. Additionally, insulated pole top pins (P6B and P6C), long strain insulators (I2), guy strain insulator (TI95B, TI95C, TI95D), and wood braces (TB60 & B37B) may be used to provide the necessary separation if it cannot be met with standard hardware.

In design and construction of pole tops, avoid shorting out the insulation provided by air and wood with steel crossarm braces, steel hardware, ground wires, guy wires, etc. The total distance measured over insulators, wood, and air should be as great as possible.

Supersedes 7/08 Issue – Paging revisions.

7.11.50 Climbing Space

Standard pole top designs shall meet or exceed code requirements for vertical or lateral clearance for line conductors at different levels attached to the same pole. When various designs are combined, however, or when work is done on an existing pole, care should be taken to provide good clearance and to maintain climbing and working space. Page 7-127 shows the NESC clearance required when workers must climb through energized conductors. This drawing should be used as a guide even when the conductors concerned are covered by protective equipment or otherwise guarded as an unvarying practice before personnel climb past them.

Those who install services and secondaries should provide enough space for the personnel who may have to climb through these services to work on the primaries above. Multiplex service taps made 3 feet or more away from the pole will help improve the climbing and working space (Reference Section 10-Secondaries, Construction Drawings).

The climbing space needs to be provided on one side or a corner of the support only.

Vertical runs physically protected by conduit or other protective covering securely attached without spacers to the surface of the pole are not considered to obstruct climbing space.

The climbing space shall extend vertically in the same position - 40 inches above and 40 inches below any wire attachment, but may otherwise be shifted to any other adjacent side or corner of the pole.

All voltages in Table 10 on Page 7-22 are between the two conductors bounding the climbing space, except for communications conductors, which are voltage to ground. Where two conductors are in different circuits, the voltage between conductors shall be the arithmetic sum of the voltages of each conductor to ground for a grounded circuit or phase to phase for an ungrounded circuit.

Table 10
Horizontal Climbing Space Between Conductors
(Reference: NESC Rule 236 and Table 236-1)

Character of Conductors Adjacent to Climbing Space	Voltage of Conductors	Horizontal Clearance Between Conductors Bounding the Climbing Space[2]			
		On S.O. Structures used Solely By:		On J.O. Structures	
		Communication Conductors (Inches)	Supply Conductors (Inches)	Supply Conductors Above Communications Conductors (Inches)	Communication Conductors Above Supply Conductors[3] (Inches)
1. Communication conductors	0 to 150 V	No Requirements	--	See Footnote 1	No Requirements
	Over 150 V	24 Recommended	--	See Footnote 1	24 Recommended
2. Lashed aerial cables (insulated and shielded) installed according to these standards (i.e. meeting NESC Rule 230C1)	All	--	--	See Footnote 1	No Requirements
3. Insulated, nonshielded cable operated at not over 5 kV phase to phase, or 2.9 kV phase to ground, supported on and cabled together with an effectively grounded bare messenger or neutral (i.e. meeting NESC Rule 230C3).	All	--	24	24	30
4. Open supply line conductors and covered supply cables, including spacer cable and tree wire (i.e. meeting NESC Rule 230D)	0-750 V	--	24	24	30
	750 V-15 kV	--	30	30	30
	15 kV-28 kV	--	36	36	36
	28 kV-38 kV	--	40	40	
	38 kV-50 kV	--	46	46	
	50 kV-73 kV	--	54	54	
	Over 73 kV	--	>54		

Supersedes 7/08 Issue – Paging revisions.

FOOTNOTES:

1. Climbing space shall be the same as required for the supply conductors immediately above, with a maximum of 30 inches except that a climbing space of 16 inches across the line may be used for communication cables or conductors where the only supply conductors at a higher level are 0 to 750 V secondaries supplying airport or airway marker lights or crossing over the communication line and attached to the pole top or a pole-top extension fixture.

2. Attention is called to the operating requirements of NESC Rules 441A and 446C.

3. This relation of levels in general is not desirable and should be avoided.

4. The climbing space specified in Table 10 above shall be provided above the top support arm to the ridge pin conductor but need not be carried past it.

5. All supply equipment such as transformers, capacitors, cable terminations, switches, etc. when located below conductors or other attachments, shall be mounted outside the climbing space.

7.12 CLEARANCE TO PROPERTY LINE

In general, conductors and supports shall not overhang property lines unless a right of way or easement has been obtained. In checking overhang, it should be assumed that conductors on rigid supports will be deflected by wind at the amount calculated on Page 7-124.

Plan for future buildings or structures along the property lines, or, if local ordinances specify, along the established building line. If it is probable that a structure will be erected in the foreseeable future, the right-of-way should be adequate to provide standard clearances to such a structure.

7.13 VERTICAL CLEARANCE BETWEEN WIRES, CONDUCTORS & CABLES AT POINT OF CROSSING DIFFERENT SUPPORTING STRUCTURES

It is generally undesirable to build a distribution line directly over or under another line. Where this cannot be avoided, clearance should be provided so that a worker on the top of a pole will be able to maintain adequate working clearances from conductors overhead. Six feet of clearance from the pole top to overhead distribution conductors at 60°F/15°C final sag is suggested as a minimum. See Sub-Transmission or Transmission Standards for voltages over 22 kV.

Supersedes 7/08 Issue – Paging revisions.

Table 11
Vertical Clearance Between Wires, Conductors, and Cables Carried on Different Supporting Structures
(Reference: NESC Rule 233, Table 233-1)

Column	Section Heading
1	Effectively grounded supply guys,[7] span wires and messengers, neutral conductors effectively grounded throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1), and overhead shield/surge-protection wires
2	Effectively grounded communication guys,[7] span wires and communication conductors and cables
3	Lashed aerial cables (insulated and shielded) installed according to these standards (i.e. meeting NESC Rule 230C1), and insulated supply cables of 0 to 750 V (i.e. meeting NESC Rule 230C2 or 230C3)
4	Open supply conductors 0 to 750 V,[6] and insulated supply cables over 750 V other than lashed aerial cables (i.e. meeting NESC Rule 230C2 or 230C3)
5	Open supply conductors over 750 V to 22 kV

	Upper Level				
Lower Level	1 (ft)	2 (ft)	3 (ft)	4 (ft)	5 (ft)
1. Effectively grounded supply guys,[7] span wires and messengers, neutral conductors effectively grounded throughout their length and associated with circuits of 0 to 22 kV phase to ground, and overhead shield/surge-protection wires	2[1,2]	2[1,2]	2[2]	2	2
2. Effectively grounded communication guys,[7] span wires and communication conductors and cables	2[1]	2[1,2]	2	4[8]	5[7]
3. Lashed aerial cables (insulated and shielded) installed according to these standards, and insulated supply cables of 0 to 750 V	2	2	2	2	2
4. Open supply conductors 0 to 750 V,[6] and insulated supply cables over 750 V other than lashed aerial cables	2	4[9]	2	2	2
5. Open supply conductors, 750 V to 22 kV	2	5[5,9]	2[9]	2[9]	2

FOOTNOTES:

Note: Footnotes 3, 4, 6, are not used.

1. No clearance is specified between guys or span wires that are electrically interconnected.

2. The clearance of communication conductors and their guy span, and messenger wires from each other in locations where no other classes of conductors are involved may be reduced by mutual consent of the parties concerned, subject to the approval of the regulatory body having jurisdiction, except for fire-alarm conductors and conductors used in the operation of railroads.

5. This clearance may be reduced to 4 feet where supply conductors of 750 V to 8.7 kV cross a communication line more than 6 feet horizontally from the communications structure.

6. Does not include neutral conductors effectively grounded throughout their length and associated with circuits of 0 to 22 kV phase to ground (i.e. meeting NESC Rule 230E1).

7. These clearances may be reduced by not more than 25% to a guy insulator, provided that full clearance is maintained to its metallic end fittings and the guy wires. The clearance to an insulated section of a guy between two insulators may be reduced by not more than 25% provided that full clearance is maintained to the uninsulated portion of the guy.

8. This clearance may be reduced to 2 feet for supply service drops.

9. In general, this type of crossing is not recommended.

7.14 CLEARANCES OF VERTICAL & LATERAL SUPPLY CONDUCTORS FROM OTHER WIRES & SURFACES OF THE SAME STRUCTURE

Table 12[1]
Clearance of Open Lateral[2] and Vertical Conductors (Inches)
(Reference: NESC Rule 239E, Tables 239-1)

	Phase to Phase Voltage				
Clearances of Open Vertical & Lateral Conductors	**0-8.7 kV (Inches)**	**8.7-15 kV (Inches)**	**15-25 kV (Inches**	**25-35 kV (Inches)**	**35-50 kV (Inches)**
From Surfaces of Supports	3[3]	5	7	9	12
From Span Guys and Messenger Wires[6]	6[4]	9	13	17	23
Anchor Guys	6	8	11	13	17

Table 13[5]
Clearances Between Open Vertical Conductors and Pole Surface (Figures 6 & 7)
(Reference: NESC Rule 239E, Tables 239-2)

Clearances of Open Vertical & Lateral Conductors	**Effectively Grounded Circuits (Φ-G) Voltage**	**Not Effectively Grounded Circuits (Φ-Φ) Voltage**	**A. Zones Above & Below Conductor Where Clearances May Apply**	**B. Minimum Clearance Between Vertical Conductor & Pole Center**
	(kV)	**(kV)**	**(Feet)**	**(Inches)**
From Surfaces of Supports	0 to 22	0 to 22	6	19
From Span, Guy and Messenger Wires[6]	22 to 30	22 to 30	6	22
Anchor Guys	30 to 50	30 to 50	6	30

Supersedes 7/08 Issue – Paging revisions.

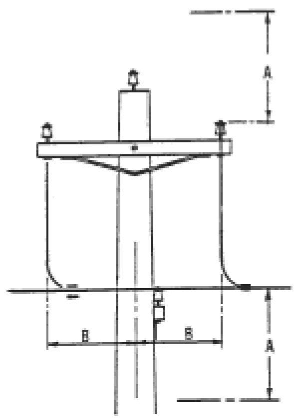


Figure 6

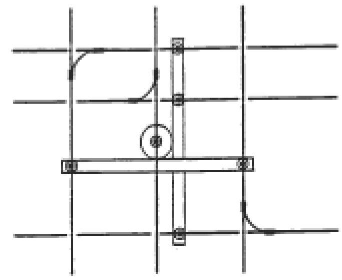


Figure 7

A = zone above and below conductor
B = distance between vertical wire and pole center

FOOTNOTES:

1. Table 12 applies to supply conductors on supply line structures or within the supply space of jointly used poles.

2. Lateral - A wire or cable extending in a general horizontal direction at an angle to the general direction of the line conductors.

3. Clearance may be reduced to 1 inch for supply circuits 0 to 750 volts. A neutral conductor may be attached directly to the structure surface.

4. Clearance may be reduced to 2 inches for insulated non-shielded cable operated at 0 to 750 volts and supported on and cabled together with an effectively grounded bare messenger.

5. If open wire conductors are within 4 feet of the pole, vertical conductors shall be run in one of the following ways:

   a. Open vertical conductors shall have the clearances given in Table 13 within the zone specified in the table.
   b. Within the zone above and below open supply conductors, as given in Table 13, vertical and lateral conductors may be enclosed in nonmetallic conduit or in cable protected by an insulated covering and may be run on the pole surface.
   c. Grounding conductors may be run on the pole surface without molding.

6. These clearances may be reduced by not more than 25% to a guy insulator, provided that full clearance is maintained to its metallic end fittings and the guy wires. The clearance to an insulated section of a guy between two insulators may be reduced by not more than 25% provided that full clearance is maintained to the uninsulated portion of the guy.

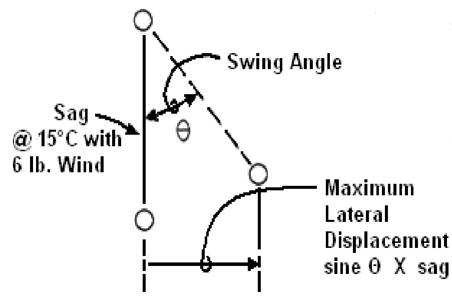
Supersedes 7/08 Issue – Paging revisions.

Basic HORIZONTAL clearances shown in Tables 2, 4, 6, 7, 8, and 11 must be increased as follows to allow for wind caused lateral conductor displacement. For horizontal adders between conductors carried on different poles (Table 11), apply adder for only one of the conductors.

The vertical sag at 60°F/15°C final with 6 lb. wind taken from Section 6-Primary Conductors for the subject conductor and span is multiplied by the sine of the conductor's swing angle to obtain maximum conductor horizontal movement.

The sine of the swing angle may be calculated or taken from the following table (rounding up to the next value shown).

Swing Angle (Θ)	Sine
25°	0.4226
30°	0.5000
35°	0.5736
40°	0.6428
45°	0.7071
50°	0.7660
55°	0.8192
60°	0.8660



Example:

For a 200 feet span of 336.4 kcm AAC 19 Strand Bare (Std. Item W20B)

1. Swing Angle = 46.5degrees (from Page 6-121)
2. Multiplier = 0.7660 (from table above for 50°)
3. Sag at 60°F/15°C, 6 lb. wind for 200 foot span = 48.36 inches (from Page 6-122)
4. Maximum Lateral Displacement = (48.36 inches) X (0.7660) = 37.04 inches

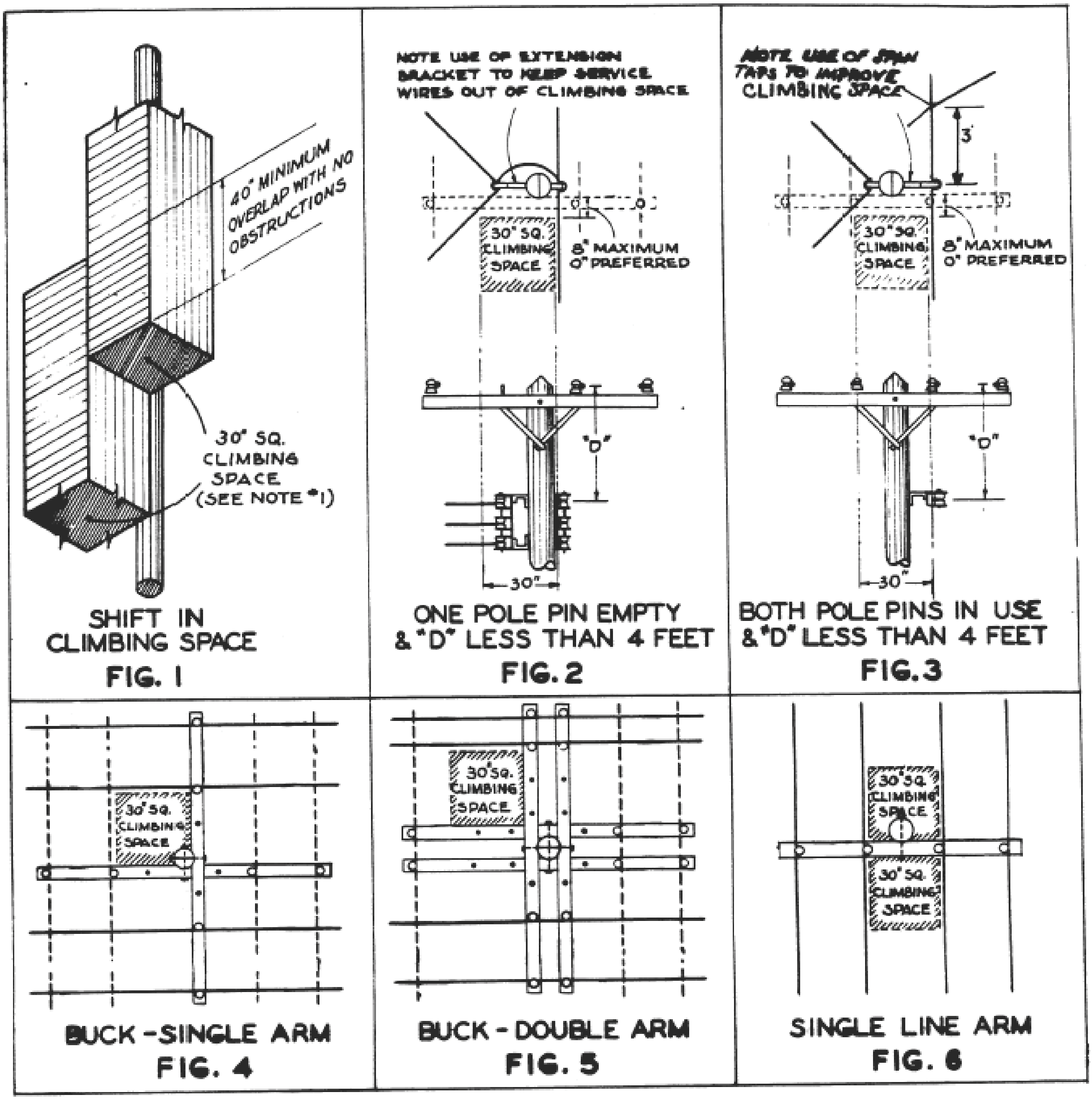
Note:

If point of conflict is not at point of maximum sag, the additional horizontal clearance may be reduced as follows:

If the distance between point of crossing or clearance and the nearest support is ___% of the total span, multiply additional clearance by the multiplier outlined below.

Percent of Span	Multiplier
5%	0.19
10%	0.36
15%	0.51
20%	0.64
25%	0.75
30%	0.84
35%	0.91
40%	0.96
45%	0.99
50%	1.00
*Interpolate for intermediate vales or use next higher multiplier.	

Supersedes 1/06 Issue – Corrected conductor information page references.



SHIFT IN CLIMBING SPACE
FIG. 1

ONE POLE PIN EMPTY & "D" LESS THAN 4 FEET
FIG. 2

BOTH POLE PINS IN USE & "D" LESS THAN 4 FEET
FIG. 3

BUCK - SINGLE ARM
FIG. 4

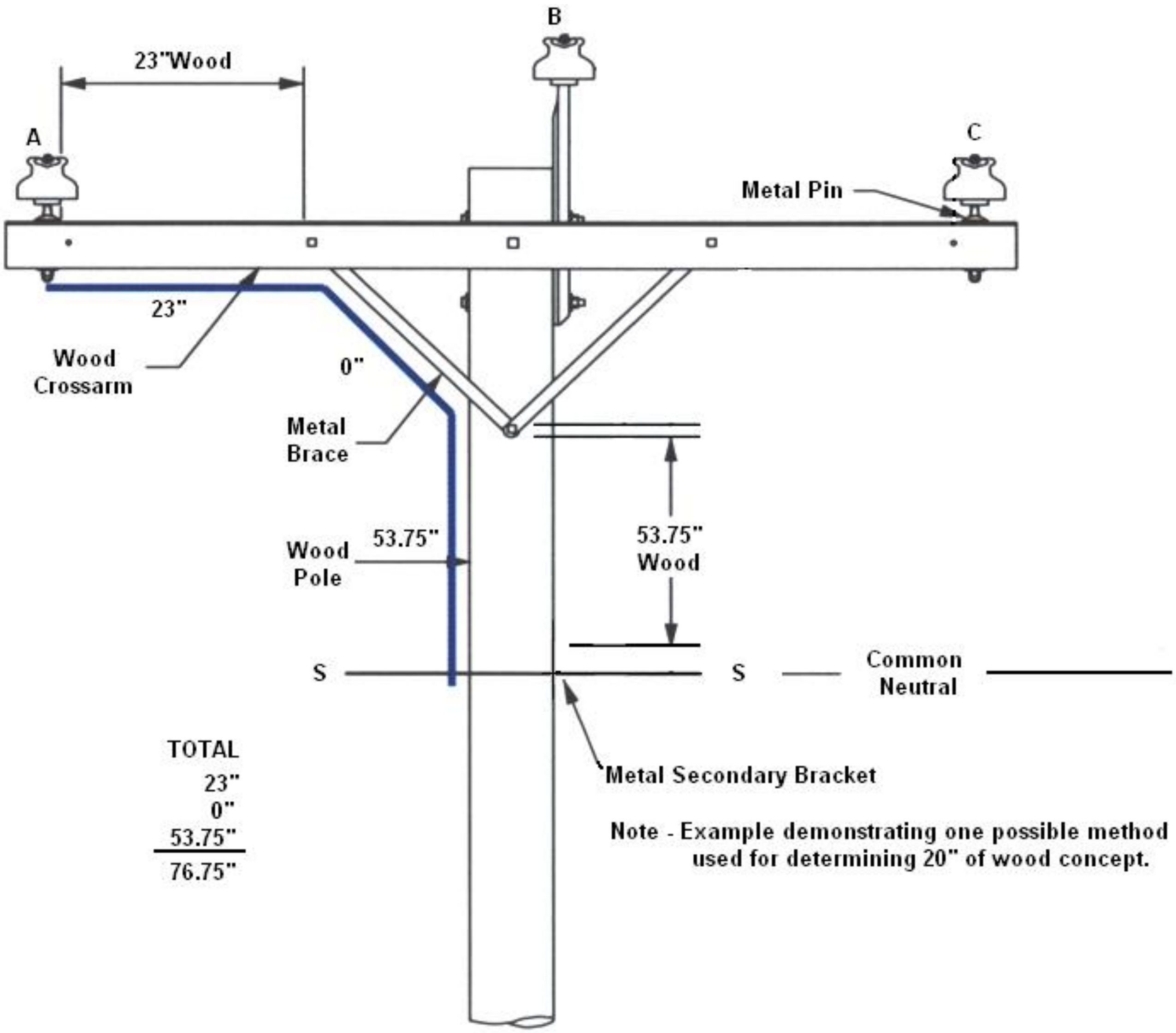
BUCK - DOUBLE ARM
FIG. 5

SINGLE LINE ARM
FIG. 6

Notes:

1. The climbing space should preferably be continuous from the ground to beyond the top of the pole; but when necessary, it may be shifted from one quarter of the pole to another provided the sections overlap at least 40 inches and there are no obstructions between the two climbing space columns. The climbing space column should extend 40 inches above and below the limiting conductors, but need not extend above a pole top pin.

2. Climbing space should be located in the quarter of the pole not occupied by risers.



To resist current leakage or electrical flashover a minimum amount of 20" of wood and effective insulation is needed. Non-conducting material such as air, wood, porcelain, or fiberglass is taken together to determine the insulation level.

Keep as much air, wood, porcelain and fiberglass between phase and ground and between phases as is practicable. The above drawing illustrates the 20 inches of wood concept.

Spacing can be increased by
:

1. Relocating hardware, pins, deadends, guy attachments, etc.
2. Using wood braces.
3. Using fiberglass pole top pin.
4. Using fiberglass guy insulator or extra insulators in deadends.

For applications where surge arresters are used, this 20 inches of wood requirement does not apply for the particular conductor having the arrester.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
8	07/19	• Added information about required clearances within state highway rights-of-way in new Section 7.4 on page 7-6.		
7	07/18	• Corrected page reference in Section 7.11.10 on page 7-19. • Corrected conductor information page references on page 7-124.		
6	07/17	• Added "effectively" to "grounded guys" when allowing reduced clearances to guy wires – Table 6, FN7, page 7-17.		
5	07/16	• Page 7-8 – revise Footnotes 7 and 8 to reflect 2017 NESC revisions. • Page 7-16 – delete Footnote 1 to reflect 2017 NESC revisions.		
4	07/15	• Remove reference to nonexistent EOP from 7.0.30.		
3	07/13	• Section 7.6 - Clearances to Swimming Pools: Revised text, modified FN 7 and added FN 8.		
2	07/10	• Table 9: Revised FN 5, added new FN 6 and renumbered FNs 6 and 7 for Verizon clearances to PLAC at pole, per Verizon settlement agreement.		
1	07/08	• Under 7.0.10, modified description of role of NESC & standard. • Under 7.11.10, modified description of MCOT. • Under 7.11.10.R, fiber-optic cable information updated • Clarified conductor type descriptions on page 7-8. • Modified wire type descriptions and added water slides in Table 4. • Added FN 6, added switch handles in FN 7 on page 7-14. • Revised FNs 16 through 18 on page 7-17. • Added FNs 1 and 2 under Table 7. • Added FN 10 under Table 8. • Modified column descriptions in Table 9. • Revised FNs 1, 5, 7, 9, 10, 11 and 12 under Table 9. • Revised Conductor Descriptions for Rows in Table 10. • Modified conductor descriptions in Table 11. • Added FN 6 under Table 11.		

8.0 GENERAL

This Section covers PPL overhead distribution construction in "Coastline Areas" for secondary and primary voltages through 15 kV. A "Coastline Area" is all areas within 1/2 mile of a saltwater coastline and those areas beyond 1/2 mile from a saltwater coastline where experience shows that the area experiences heavy salt spray. **Note: This standard may also be applied where experience shows that the area experiences heavy road salt contamination.**

8.0.10 "Coastal" Environment

In the direct vicinity of the coastline, pollution is deposited onto insulators and equipment mainly by spray, wind and fog. The pollution build-up is generally rapid, especially during spray or salt fog conditions. A build-up of pollution over a longer term can also occur through a deposit of wind-borne particles, consisting of quick dissolving and inert components that vary depending on local soil characteristics. Natural cleaning of the insulators by rain is typically effective as the active component of the pollution consists mainly of fast dissolving salts. Reference IEC Standard 60815-1.

8.0.11 Approach

The following standard guidelines have been developed based on field experience in salt contaminated areas and the identification of equipment deterioration caused by tracking or corrosion. This is standard is a "working standard" meaning that it is under continuous development and new guidelines will be issued as additional information is received by Standards regarding equipment that has deteriorated due to salt contamination.

8.1 CONSTRUCTION TYPE

Overhead construction in "Coastline Areas" is generally the same as in other areas with the exception of some changes in the materials used. This standard identifies a list of materials to be used for **Standard Construction** (materials used in other areas) or **Coastline Construction** (materials used in Coastline Areas).

8.2 CORROSION

8.2.10 Types of Corrosion

There are two types of corrosion, Oxidation and Galvanic.

8.2.11 Oxidation Corrosion

Oxidation corrosion of metals occurs in the presence of oxygen with or without the presence of water. Metal oxides begin to form on the surface of metals as soon as they are exposed to air.

8.2.12 Copper Oxidation

On copper, a solid layer of copper oxides will form, providing some protection from additional oxidation corrosion and significantly reducing the electrical conductivity of the surface of the copper. The thickness of the oxide layer on copper will vary depending on the temperature of the copper and will appear as a black or green surface discoloration of the copper. Copper oxide layers will reduce the number and area of contacting points in a connection, thus increasing the contact resistance. Copper conductors must be cleaned prior to making a connection.

8.2.13 Aluminum Oxidation

On aluminum, a solid layer of aluminum oxides will form, providing protection from additional oxidation corrosion and significantly reducing the electrical conductivity of the surface of the aluminum. Oxide growth is self-limiting on aluminum (~2 nanometers thickness) and is usually transparent to the eye. Oxide growth rate on aluminum depends on humidity and temperature. Aluminum oxide is a fast forming, hard, non-conductive coating that develops on the surface of aluminum conductors exposed to air. Unlike copper oxides, aluminum oxide is not visually obvious and should be assumed to exist in all cases of bare aluminum. Aluminum oxide must be removed from a conductor's surface prior to making a connection. **Wire brushing and the immediate application of an oxide inhibitor is required to prevent the reformation of this non-conductive oxide layer prior to connector installation.**

8.2.14 Steel & Iron Oxidation

A layer of iron oxides will form on steel or iron but will not become solid enough to protect the underlying metal from further oxidation. The underlying steel or iron will continue to be exposed to air and oxidation corrosion will continue until the iron or steel is fully consumed. To protect iron and steel from corrosion, the company normally uses either barrier coatings, such as paint, that protect the metal from exposure to air or galvanic coatings, such as zinc, that sacrifice themselves to protect the underlying metal.

8.2.15 Galvanic Corrosion

Galvanic corrosion is the electrolytic action of moisture and other elements of the atmosphere in conjunction with dissimilar metals. This will happen with the metals in electrical connections. Galvanic corrosion is a minor issue in copper or copper alloy connections; however, it is a significant issue if aluminum and copper are involved, unless moisture can be kept away from the connection.

Galvanic corrosion occurs when dissimilar metals are in the presence of an electrolyte with the metals acting as a battery. The metal with the more negative galvanic potential (the anode) loses electrons to the other metal (the cathode) releasing additional ions into the electrolyte and resulting in the loss of material from the anode. Like metals in direct contact are subject to minimal, if any, galvanic corrosion as an electric potential is difficult to establish.

In electrical connections between dissimilar metals (copper to aluminum) galvanic corrosion will occur when an electrolyte is present. Salt contamination on electrical facilities becomes a strong electrolyte when wet from drizzle, fog or high humidity that will promote galvanic corrosion at connections between dissimilar metals. In electrical connections between similar metals (copper to copper or aluminum to aluminum) little galvanic corrosion will occur.

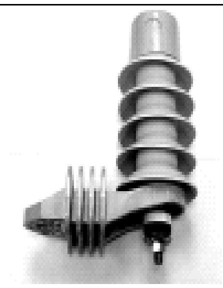
Galvanic corrosion can be controlled in Coastal Areas by keeping electrolytes (salt and water) away from the electrical connection. This standard emphasizes the use of sealed piercing connectors, cold shrink and gel wrap covers and corrosion inhibitors as ways of keeping electrolytes away from electrical connections.

Supersedes 7/14 Issue – Corrected section title numbering.

8.3 CONSTRUCTION MATERIAL

8.3.10 Arresters

Riser Arresters – 12kV
Standard Construction – Use standard riser arresters.
Coastline Construction – Use extra creepage riser pole arrester

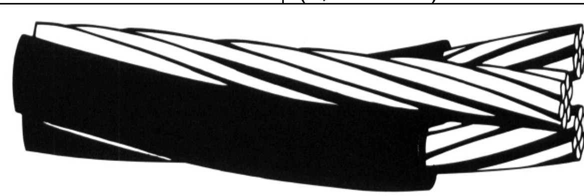
Standard Construction	Coastline Construction
12kV Arrester	12kV Arrester with extra creepage
Std Item L3ER	Std Item L3ERN
	

8.3.11 Cables

Aluminum secondary/service 600V insulated overhead cables can be used in a Coastal Area. To prevent galvanic corrosion, salt and water must not be able to penetrate the area between the phase conductor insulation and the conductor. Care must be taken during installation to avoid damaging the cable insulation. All phase conductor connections must be made with insulated piercing connectors. Bare aluminum neutrals can be connected with H-Tap connectors. **Be sure to wire brush the conductors first.** Exposed secondary cable phase conductor ends must be covered with cold shrink end caps (Std Item UC90C) to prevent salt contamination. In addition, the cold shrink end caps must be covered with one layer of vinyl plastic black insulating tape (Std Item T2W1) to protect it from ultraviolet (UV) light exposure.

Standard Construction – #2 or 1/0 Aluminum triplex cable
Coastline Construction – #2 or 1/0 Aluminum triplex cable

Standard Construction	Coastline Construction
#2 Aluminum Triplex – Std Item W15B (500' coil)	#2 Aluminum Triplex – Std Item W15B (500' coil)
#2 Aluminum Triplex – Std Item W15B (1,200' reel)	#2 Aluminum Triplex – Std Item W15B (1,200' reel)
1/0 Aluminum Triplex – Std Item W15C (500' coil)	1/0 Aluminum Triplex – Std Item W15C (500' coil)
1/0 Aluminum Triplex – Std Item W15C (1,000' reel)	1/0 Aluminum Triplex – Std Item W15C (1,200' reel)



8.3.12 Connectors

(A) Secondary/services connectors
Standard Construction - H-Tap compression connectors with plastic covers.

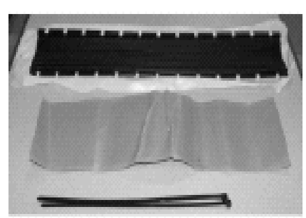
Coastline Construction – Weatherproof piercing connectors or H-tap with Gel-filled enclosure cover.

Standard Construction	**Coastline Construction**	
H-Tap Compression Connectors w/Covers	Weatherproof Piercing Connector	H-Tap compression connector with gel filled enclosure cover
Conductor Range #8 to 1/0 Al & Cu	Conductor Range #8 to 1/0 Al &Cu	Conductor Range #8 to 1/0 Al & Cu
Std Item S13	Std Item S5	Std Items C61A & C61B
		

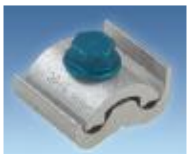
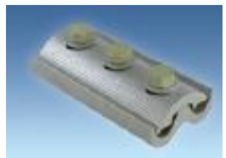
(B) Primary connectors

Spacer cable/Tree wire compression splice

Standard construction and Coastline construction on spacer cable/tree wire require that all splices be covered with cold shrink covers for new installations and Gelwrap covers for existing splices that were never covered but should be.

Standard & Coastline Construction
Splice with Cold shrink or Gelwrap waterproof cover
Conductor Range 1/0 thru 795kcmil
Cold Shrink cover – 336.4 thru 795kcmil (Not suitable for 1/0) Std Item S16
Gelwrap Cover 1/0 thru 556.4kcmil Std Item C62
Gelwrap Cover 336.4 thru 795kcmil Std Item C63
  

(C) Spacer cable/Tree wire tap – Bolted Parallel groove connector
Standard Construction – Bolted parallel groove connector with no covering
Coastline Construction – Bolted parallel groove connector with Gelwrap waterproofing cover.

Standard Construction	**Coastline Construction**
Parallel Groove Connector - Bare	Parallel Groove Connector with Gelwrap cover
Conductor Range 1/0 thru 795kcmil	Conductor Range 1/0 thru 795kcmil
	For small 1 bolt connector Std Item C67
	For large 2 & 3 bolt connectors Std Item C68
  	

8.3.13 Cutouts

15kV – 100 AMP
Standard Construction – Use standard 15kV polymer cutouts.
Coastline Construction – Use 27kV polymer cutouts for extra creepage distance.

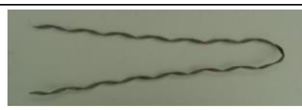
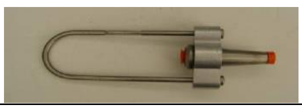
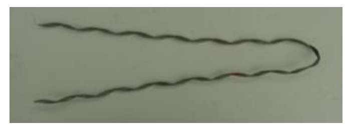
Standard Construction	**Coastline Construction**
15kV Polymer Cutout	27kV Polymer Cutout
Std Item C43S10	Std Item C43S41
	

23kV – 35kV
Cutouts for this application are still under investigation for future incorporation into these Coastline Construction standards. Please contact Standards Engineering on a case-by-case basis for particular situations.

Supersedes 7/13 Issue – Corrected section numbering.

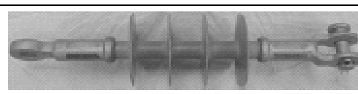
8.3.14 Guying

<u>Guy Deadends</u> (Down guys and span guys)
Standard Construction – Use a preformed guy deadend on one end of guy wire and an automatic deadend on the other end of guy wire for ease of deadending the guy wire.
Coastline Construction – Used a preformed guy deadend on both ends of the guy wire. Automatic deadends corrode and fail in service.

Standard Construction	**Coastline Construction**
Preformed and automatic deadend	Preformed deadend
12.5M Guy Wire	12.5M Guy Wire
12.5M Preformed Std Item P54E	12.5M Preformed Std Item P54E
12.5M Automatic (Short bail) Std Item G5C4	
12.5M Automatic (Long bail) Std Item G5C4L	
 	

8.3.15 Insulators and Copper Automatic Deadends

<u>Dead End Insulators</u>
Standard construction and Coastline construction use the same polymer deadend insulator because the creepage distance is adequate for both constructions.

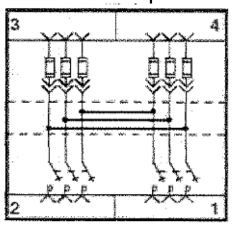
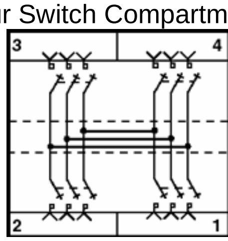
Standard & Coastline Construction
Polymer Deadend Insulator
15kV Insulator Std Item I7PA
35kV Insulator Std Item I7PB


Supersedes 7/13 Issue – Corrected section numbering and table alignment.

Supersedes 7/13 Issue – Revised Switchgear table to include currently used PME-9 and PME-10.

8.3.16 Switchgear

Three phase 14.4kV, 600A, low-profile, padmounted, outdoor, metal-enclosed switchgear containing gang operated loadbreak switches and S&C type SML-20 loadbreak power fuses.
Standard Construction – Steel Cabinet
Coastline Construction - Stainless Steel Cabinet

SWITCHGEAR – 14.4KV, 600 AMP.		
CONFIGURATION	**Standards Construction** **STD ITEM**	**Coastline Construction** **STD ITEM**
PME-9 Two Switch Compartments Two Fuse Compartments 	US45 Steel Cabinet	US45SS Stainless Steel Cabinet
PME-10 Four Switch Compartments 	US45A Steel Cabinet	US45ASS Stainless Steel Cabinet

8.3.17 Transformers

(A) Pole Type Transformers
Standard Construction – Use standard steel conventional transformers.
Coastline Construction – Use stainless steel conventional transformers.

TRANSFORMER, SINGLE – PHASE POLE TYPE						
			Standards Construction		**Coastline Construction**	
			Conventional Steel Transformer MS 2523		**Stainless Steel Transformer MS 2526**	
PRIMARY VOLTAGE	**SECONDARY VOLTAGE**	**KVA**	**PHYSICAL DATA CODE**	**STD ITEM**	**PHYSICAL DATA CODE**	**STD ITEM**
12470GrdY/7200	120 / 240	25 50	10-165-10-00-00	T91CB	11-165-10-00-00	T91CBS
13200GrdY/ 7620	120 / 240	10 25 50 75 100 167	10-167-10-00-00	T91DE	11-167-10-00-00	T91HPS
13800GrdY/7970	120 / 240	25 50	10-169-10-00-00	T91EB	11-169-10-00-00	T91HQS
4160GrdY/2400 X 13800GrdY/7970	120 / 240	25 50	10-317-33-00-00	T91HF3	11-317-10-00-00	T91AJS

(B) Single Phase Padmount (Minipad) Transformers
Standard Construction – Use standard steel conventional transformers.
Coastline Construction – Use stainless steel conventional transformers

TRANSFORMER, SINGLE – PHASE PADMOUNT (MINIPAD) TYPE						
			Standards Construction		Coastline Construction	
			Conventional Steel Transformer MS 2561		Stainless Steel Transformer MS 2562	
PRIMARY VOLTAGE	SECONDARY VOLTAGE	KVA	PHYSICAL DATA CODE	STD ITEM	PHYSICAL DATA CODE	STD ITEM
4160GrdY/2400 X 13800GrdY/7970	240/120	25	30-317-16-00-05	UT31E	31-317-16-00-05	UT31ES
		50				
12470GrdY/7200	240/120	25	30-165-16-00-05	UT31G	31-165-16-00-05	UT31GS
		50				
13200GrdY/ 7620	240/120	25	30-167-16-00-05	UT31H	31-167-16-00-05	UT31HS
		50				
		75				
		100				
		167				
13800GrdY/7970	240/120	25	30-169-16-00-05	UT31J	31-169-16-00-05	UT31JS
		50				

TRANSFORMER, THREE – PHASE WYE-WYE PADMOUNT TYPE						
			Standards Construction		Coastline Construction	
			Conventional Steel Transformer MS 2572		Stainless Steel Transformer MS 2575	
PRIMARY VOLTAGE	SECONDARY VOLTAGE	KVA	PHYSICAL DATA CODE	STD ITEM	PHYSICAL DATA CODE	STD ITEM
13200GrdY/ 7620	208Y/120	75	30-691-73-00-05	UT42H	31-691-73-00-05	UT42HS
		150				
		300				
		500				
13200GrdY/ 7620	480Y/277	75	30-691-74-00-05	UT47H	31-691-74-00-05	UT47HS
		150				
		300				
		500				
		750				

Supersedes 7/09 Issue – Removed Item ID’ s – see Section 22.

8.4 ADDITIONAL GUIDELINES REGARDING CONSTRUCTION IN SALT CONTAMINATED AREAS

8.4.10 Conductors

- All bare aluminum alloy primary conductors (AAC & AAAC) are acceptable for use in Coastline Construction.
- Aluminum Conductor Steel Reinforced (ACSR) conductors are not an acceptable conductor for use in Coastline Construction due to the potential for corrosion between the steel and aluminum conductors.

8.4.11 Hardware

- Galvanized mild steel hardware corrodes badly and becomes unsightly in three to five years.
- Stainless steel, Duronze, and other metals all have excellent corrosion resistance.
- Aluminum hardware works well.
- Properly applied, aluminum hardware items show excellent resistance to marine corrosion and are expected to last as long as the pole on which they are installed. Their higher initial cost should be offset by drop in replacement costs.
- The following aluminum alloys are acceptable
  - ♦ Cast alloy ASTM 356-T6
  - ♦ Wrought alloys ASTM 6061-T6, 6151-T6, and 2024-T4.
  - ♦ Alloy ASTM 2024-T4 must have a minimum anodized coating of 0.0007-in. for exposure to a marine atmosphere.

8.4.12 Poles

Fill old bolt holes with Alvania No 2 grease before installing aluminum bolts (2024 or 6061-T6 Alloy) in creosoted poles. Otherwise, Poultice attack of the bolts will occur. This attack causes some corrosion where the bolt enters and exits the pole hole. Only minor corrosion occurs. Exposed portions of the aluminum bolts will remain in excellent condition.

Supersedes 7/13 Issue – Corrected section numbering.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
4	7/20	• Revised Switchgear table on page 8-7 to include currently used PME-9 and PME-10. • Revised numbering in index. • Corrected section numbering and table alignment on pages 8-3 through 8-6.		
3	7/14	• Added H connector Gel covers for secondaries • Corrected table in 8.2.17		
2	7/13	• Removed Item ID's from entire section. • Added Copper Deadends in Section 8.2.21 on Page 8-6		
1	7/09	New Section		

Supersedes 7/20 Issue – Corrected titles for 9-415F, 9-416F, and 9-417F.

Supersedes 7/19 Issue – Corrected title block text.

Supersedes 7/16 Issue – Corrected title block text.

Supersedes 7/16 Issue – Corrected title block text.

9.0 GENERAL

This section includes the design and construction requirements necessary for overhead distribution lines in a crossarm or armless configuration and for single or multiple phases at 15kV primary distribution voltage levels and below. The following Standards shall be used for the design and construction of all new lines, line reconductoring projects, voltage conversion projects, and for pole replacements. Existing facilities should be modified to the current Standards when it is economically feasible to do so. For 25kV and 35kV class circuits, refer to Section 20 or Section 21 of the Overhead Standards book.

9.0.10 Voltage Classes

For the purpose of simplifying the terminology to be used in various descriptions of the following drawings, the voltage class designations are as follows:

5 kV - This designation is generally referred to primary circuit voltages of 5 kV and below regardless if the system is effectively grounded or non-effectively grounded.

15 kV - This designation is generally referred to primary circuit voltages of 15kV and below regardless if the system is effectively grounded or non-effectively grounded.

Refer to Pages 1-1 and 1-2 in the Overhead Standards book for specific voltages within the classes.

9.0.20 Coordination With Other Parties

Contact shall occur with all necessary communication companies and municipalities during the initial planning stages so that all parties may properly coordinate their required activities. Construction shall be coordinated to allow for maximum system reliability and efficiency.

9.1 DESIGN OF PRIMARY FEEDERS

The standard 3 phase distribution feeder shall be 4 wire (three conductors, one neutral) multi-grounded wye. The objective is to design and safely construct distribution lines that will provide maximum service reliability at a reasonable cost. This can be attained by routing feeders through minimum tree and traffic exposure, employing the proper type of conductors for the conditions along the route, and providing circuit capacity for normal and reasonably probable contingency conditions, including anticipated load growth.

9.1.10 Routing

The route of the feeder should be such that normally only one distribution circuit is placed on a pole line. Where this is not possible, an effort should be made such that one feeder shall serve the local load while additional express feeders utilizing spacer cable or Preassembled Lashed Aerial Cable (PLAC) are carried through the area.

When feeder construction is necessary along the route of an existing subtransmission circuit, consider underbuilding the subtransmission circuit verses installing a duplicate pole line or major undergrounding. Underbuild of subtransmission can be used if the subtransmission is accessible by bucket truck for normal maintenance and can be taken out of service if required. Seven (7) foot minimum vertical clearance between upper and lower circuits is recommended for worker safety. Approval from the Transmission or Subtransmission Engineering Department is required.

Supersedes 7/07 Issue – Editorial changes.

9.1.20 Basic Impulse Insulation Level (BIL)

BIL refers to the ability of the pole top design to resist flashovers caused by lightning or line surges. Surge arresters, coordinated to the BIL of the equipment, are installed to limit the overvoltages on equipment by discharging surge current to ground.

Pole tops are designed to provide a minimum of 150 kV insulation impulse withstand. This impulse level is based on the assumed impulse flashover strength of 20 inches or more of wood.

Where lightning arresters are used and where grounding conductors are installed, the 20 inches of wood requirement does not apply for the particular conductor having the arrester. In locations where sufficient wood separation is not obtainable, the use of fiberglass strain insulators shall be installed. Fiberglass guy strain insulators shall be installed onto all new primary guy installations maintaining BIL requirements - refer to Section 3 for guying requirements.

See Section 7 for additional BIL information and drawings.

9.1.30 Size and Loading of Conductors

The initial load on the conductors of the feeder main and taps/branches shall be limited to allow reasonable load growth before the maximum normal peak load limit is reached. This initial load value should allow for a minimum of 10 years of additional expected load growth. The current values for normal and emergency loads are based on consideration of economy with respect to losses and the thermal limits of the conductor. See Section 6 - Primary Conductors for more information on specific primary conductors.

A. Size of Main Line Conductors

15 kV new main line feeders shall utilize 336.4 kcmil or 477 kcmil All Aluminum Conductors (AAC) primary conductors however, upon Engineering approval, 795 kcmil AAC is available. Existing conductors of adequate size may serve for part of any feeder main (see Section 9.3.50) and use of any other conductor size for this purpose will be considered on a case-by-case basis. See Section 6 - Primary Conductors for additional information.

B. Size of Tap (Branch Line) Conductors

Three phase taps shall utilize 1/0 All Aluminum Alloy Conductor (AAAC), 336.4 kcmil AAC, or 477 kcmil AAC primary conductors.

Generally single phase taps shall utilize 1/0 AAAC conductor for expected loading up to 100A. Loadings above this value require the addition of one or more phases.

In existing taps that have a conductor smaller than #2 where it is not economically feasible to reconductor the line or convert it to a higher voltage, step down transformers should be installed.

C. Size of Grounded Neutral Conductors

Maintain a common neutral with minimum splices for effectively grounded circuits.
Note: See Sections 13.4 and 13.5 for information on the bonding of circuit neutrals.

All neutral conductors shall be 1/0 aluminum except when a larger size is either existing or necessary as part of a secondary system. Example: 4/0 AAAC is used with 336.4 kcmil multiplex. Use of a larger neutral conductor, or use of any other secondary cable

Supersedes 7/07 Issue – Editorial changes; text shift.

configuration or size, requires that National Electric Safety Code (NESC) clearances for that particular construction be met.

Generally if existing primary conductors are **smaller** than 1/0 aluminum or equivalent and a neutral conductor exists, it should be used if it is equal size or larger than the primary conductor.

If existing primary conductors are equal to or **larger** than 1/0 aluminum or equivalent and a neutral conductor exists, it should be used if it is at least equivalent to 1/0 aluminum or #3 copper. #2 ACSR (aluminum cable, steel reinforced) is also acceptable.

Existing 7/16 inch CW (copperweld) or #1 AWAC 2/5 messenger may also be used as an effectively grounded neutral, but separate secondary neutrals shall be used with this type of construction.

9.1.40 Voltage Regulation and Flicker

It is suggested that a voltage profile be run for each feeder so that regulation can be reviewed. Contact Distribution Engineering.

Voltage regulation on the primary feeder shall be such that voltage to customers can be maintain to the following acceptable levels on a 120 V base:

Rhode Island - 126 V maximum, 114 V minimum.

The voltage is controlled by the station load tap changers (LTC) transformers or station regulators, line regulators, and capacitors. Methods of setting regulators are discussed in Electric & Gas System Bulletin #206 or the Engineering Department Procedures (EDP).

Voltages on lines serving loads such as motors, welders, etc., should be checked to see that any flicker does not exceed the limits given in Section 10. Loads that may cause excessive flicker should be referred to the Distribution Engineering Department.

9.1.50 Radio and Television Interference

Radio and television interference can be caused by loosely connected equipment and materials, which could cause arcing between parts. The higher the primary voltage, the greater the possibility of creating radio and television interference. This interference can be controlled by taking reasonable care to minimize the creation of sharp projections of energized parts by properly applying insulator ties, by making certain all bolted connections on structures are properly tightened, and by maintaining suitable clearances of pole hardware.

9.2 POLE TOPS

The following can be used for pole top constructions and pole considerations.

9.2.10 Selection of Sole Owned and Jointly Owned Poles

There is no standard pole height or class that can positively meet all construction conditions without causing unnecessary expense. Selection of pole height and class requires the coordination of all pole users. Once the correct pole height and class is determined for the most common pole in the project, the remaining pole heights and classes should be easily determined with small changes made to the original calculations. See Section 2 for pole selection information.

Existing poles in sound condition and in the proper locations should be used if pole loading and minimum clearance requirements can be met for the facilities that are being installed.

Prior to changing a jointly owned pole, it should be determined that the communications company is not occupying the Company's space. If the pole must be replaced, or if new poles are to be installed, they shall be selected to provide clearances specified for present and future needs following the Joint Use Contractual Agreements. The Company may be entitled to reimbursement of transfer costs.

Whenever present and future construction requires more pole space, pole top extensions should be considered before a new, larger pole is installed.

9.2.20 Crossarm Construction

The standard primary 3 phase construction is bare wire on a crossarm, which, for a tangent pole, consists of a 6-pin-8 foot wood crossarm with wood braces, a 24 inch steel pole top pin, steel crossarm pins, and porcelain pin-type insulators for 15kV and below. This type of construction is also recommended for long span rural lines and for lines in heavy industrial areas. It may also be necessary to continue this type of construction on existing lines that are rebuilt to maintain consistency of existing crossarm construction.

Double crossarms are required at line angles over 20 degrees using pin insulators (refer to NESC Rule 261D5(c)), and at c rossings of railroads, limited access highways, and navigable waterways requiring waterway crossing permits (refer to NESC Table 242-1).

Supersedes 7/17 Issue – Corrected reference to NESC rule.

Other crossarm sizes and arrangements may be used as field conditions require. They are:

A. Two-Pin Crossarm (10 foot) – Use when specifically called for on individual standards or additional clearances are required.
B. Six -Pin Heavy Duty Crossarm (10 foot) – Use for 3000 lbs Deadend construction.
C. Extension Arms (Alley Arms) – Use when this is the only practical method of obtaining clearance from trees, buildings, etc., or for reducing or eliminating an angle in the line. In general, two or more adjacent poles with extension arms shall be used to reduce the excessive lateral stress, which may be caused by one extension arm in a straight line. Side guys or equivalent may be required to support the unbalanced load of a series of extension arms. (9-440 series)
D. Offset Arms – Use 6 pin with wood braces when the full offset of an extension arm (Alley Arm) is not required. Refer to Section 7 for adequate BIL separation. See 9-441 for Offset Arm construction drawings.
E. Fiberglass Crossarms – Fiberglass deadend crossarms are standard for most deadend applications (see individual structure drawings). Fiberglass tangent crossarms are used on fiberglass poles and when lifting weight of the arm is an issue or when strength is required without the use of crossarm braces.

9.2.30 Armless Construction

Three phase armless construction is available for distribution lines in urban and suburban residential districts for 15 kV and below if span limitations permit. It may also be considered in situations where tree trimming permission is restricted and spacer cable construction will be too costly. See drawings in the 9-800 series for armless construction details.

Supersedes 7/15 Issue – Modified 9.3.30 – tree wire may be used with armless construction. Editorial changes in 9.3.20.

Single phase armless (vertical) construction, utilizing steel pole top pin, can be used for all voltages. The drawings in the 9-700 series have various diagrams pertaining to effectively grounded and noneffectively grounded circuits.

9.2.40 Spacer Cable Construction

Spacer Cable construction is preferred for distribution lines when NESC Clearances, Tree Trimming Clearances, and Right of Way Issues can not be resolved with the recommended crossarm or armless types of construction. It may also be selected for an additional express feeder purpose similar to preassembled lashed aerial cable (PLAC).

9.2.50 Phase Position

Circuits should hold the same relative phase position throughout their entire length as far as practicable following the guidelines shown on Page 9-105. Where there is an established policy on phase position in an operating area, it may be continued.

9.3 TYPES OF CONDUCTORS

The type of conductor shall be selected as follows:

9.3.10 Bare Conductors

Bare conductors are preferred over tree wire, spacer cable and preassembled lashed aerial cable due to the cost, construction/maintenance requirements and current carrying capacity. They shall be used in areas where there are no restrictions on tree trimming (local, state, or otherwise).

9.3.20 Covered Conductors

PE covered conductor is not approved for new installations but may be used for maintenance purposes only. This conductor is designed to withstand limited incidental tree contact.

9.3.30 Tree Wire

Tree wire is an approved conductor for new installations in open wire configurations, including crossarm construction, armless construction and single phase construction. This conductor is designed to withstand incidental tree contact, but is not designed to withstand extended tree contact, nor to be installed to permanently eliminate tree trimming. Tree wire may also be installed when local municipal ordinances mandate that covered primary conductors be installed.

Although tree wire offers some electrical protection, **it is not an insulated conductor**. It must be treated as a bare conductor during installation and maintenance.

Tree Wire contains a layer of semi-conducting material at the aluminum conductor surface. **WARNING: When skinning these conductor coverings, do not allow the removed covering to contact equipment grounds or adjacent live phase conductors as an electrical flash may result.**

9.3.40 Spacer Cable

Tree wire is the only wire to be used in a spacer cable configuration. Spacer cable configuration provides maximum reliability and is to be used in heavy tree areas, but is not designed to withstand extended tree contact, nor to be installed to permanently eliminate tree trimming. See Section 16-Aerial/Spacer Cable for more information and construction details. Tree wire in a spacer cable configuration is also approved for express or multiple feeder installations on existing poles.

9.3.50 Preassembled Lashed Aerial Cable (PLAC)

Preassembled lashed aerial cable is approved for expressed or multiple feeder installations on existing poles. This eliminates the need for the installation of a second pole line. It can also be used to achieve NESC Clearance or Right of Way Issues. See Section 16 for more information on this conductor and construction details.

9.3.60 Existing Conductors

A. 5 kV - Existing conductors in good condition, may remain in place for 5kV operations. They may be repaired and maintained using the same or similar conductors. Non-standard conductors should not, however, be used for replacement of several spans, nor for adding a third phase to an existing line. When it is necessary to perform extensive repair work on an existing non-standard line, replacing it with standard conductors is required.

B. 15 kV - Do not use existing conductors smaller than #2 for 15kV effectively grounded systems. Refer to Section 14 regarding the installation of step-up/step-down transformers. Triple Braid Weatherproof (TBWP) insulated conductors should normally be replaced if it will be operating at 15 kV or above in the foreseeable future.

9.4 SEPARATION OF CONDUCTORS

9.4.10 General

Minimum recommended separations between supports and conductors on the same pole are shown on the construction drawings. These should be used on all poles for new lines. They are generally used for pole replacements.

9.4.20 Separation on New Poles

The vertical clearance between primary line conductors and neutral or secondary conductors at poles for new lines shall generally not be less than 56” for 0-15 kV. This distance allows work on the neutral or secondary while maintaining the NESC Phase to Ground Minimum Approach Distance (MAD), including a 30” dimension for “Reach” (based upon the average line worker’s extended reach from chest to finger tips of 30”).

Note: NESC Phase to Ground MAD for 15 kV = 26” + Reach of 30” = 56”

A. Primary Tangent Poles (where wires are on pin insulators and crossarms) – the vertical separation between the bolt for the primary crossarm and the secondary bracket shall be not less than 48” for 15 kV. This will allow 56” clearance between primary line conductors and the neutral or secondary conductors. The distance between the crossarm bolt and the top of the 15kV insulator holding the primary conductor is 8”. This distance plus the distance from the crossarm bolt to the secondary bracket (48”) will total a minimum of 56”.

B. Primary Deadend Poles - the vertical separation between the bolts for the primary crossarm and the secondary bracket shall be not less than 56” for 0-15 kV lines.

9.4.30 Separation on Existing Poles

When pole tops are being rearranged to accommodate additional facilities or when circuits are cut over to a higher voltage level, the recommended separations between primary line conductors and neutrals or secondaries for work on new poles **must** be used if possible. This

Supersedes 7/11 Issue - Editorial revision.

will hold future work to a minimum and allow work on secondaries without covering the primaries (NESC Minimum Approach Distance). However, extensive work and pole change outs should not be undertaken solely to reduce work that might become necessary in the future.

When pole tops are rearranged to accommodate additional facilities on the pole, without regard to the owner of the new facilities:

A. If the vertical separation between the primary and the secondary/neutral is 56" or more at the pole, a minimum vertical separation of 56" shall be maintained. This allows qualified electrical line workers to maintain MAD from the primary wires while working on the secondary/neutral at the pole.

B. If the vertical separation between the primary and the secondary/neutral is less than 56", NESC minimum vertical separations at the pole and in the span shall be maintained. See Section 7.11 (Separation of Conductors and Supports on the Same Pole) for information on these minimum clearance requirements.

9.4.40 Space Available on Jointly Owned Poles

Before replacing any jointly owned poles, be certain that communication company and other attachments cannot be rearranged to permit the desired construction.

9.4.50 Separation on Replaced Poles

The separations on poles that are replaced should conform to the requirements for new poles. In some special cases, separation may be reduced, but shall not be less than that permitted on existing poles.

9.4.60 Reduction of Separation on Poles

Reduced separations of conductors and facilities made to accommodate communication, CATV or other third party interest shall not be less than 15kV minimum requirements.

9.5 OTHER

9.5.10 Surge Arresters

See Section 13.6 (Lightning Protection) and Section 13.7 (Surge Arrester Application Table) for more information on when arresters are required and what type should be used.

9.5.20 Insulators

A. Bare Conductor – One piece radio free, pin type, porcelain insulators of the appropriate ANSI class shall be used to support the phase conductors. A one piece polymer deadend insulator of proper voltage rating shall be used to deadend the conductor.

B. Tree wire/spacer cable – A one piece, plain top, pin type, polyethylene insulator of the appropriate ANSI class shall be used to support the phase conductor. A one piece polymer deadend insulator of proper voltage rating shall be used to deadend the conductor. **Note:** do not remove conductor covering at insulator location. To maintain the integrity of the covering, it must remain intact.

9.5.30 Neutral Brackets

An uninsulated metal bracket shall be used to support the common neutral conductor in the secondary position. See Section 10 for information on Secondaries.

Supersedes 7/07 Issue - Editorial changes; text shift.

9.5.40 **Conductor Ties**

Follow these guidelines to ensure the reliability of primary circuits and to reduce or eliminate interruptions caused by inadequate conductor tie practices. Line conductors are to be positioned on its insulators that will produce minimum strain on the tie wires. The function of the tie wire is only to hold the line conductor on its insulator. Conductor strain shall be taken by the insulator and pin.

Hand wrapped ties are to be used for all types of conductor within the 15 kV class. Ties are to be made by hand and without the use of pliers. A tie wire must be neatly and tightly wrapped around the insulator and conductor with free ends wrapped tightly around the conductor. On lines that may eventually be operated above 15 kV, the free ends shall be folded back on the conductor at a distance of 3 inches to facilitate the future removal of the tie with hot sticks.

Hot line ties are to be used when lines are being worked with hot sticks. These also need to be wrapped neatly and tightly around the insulator and conductor. Single loop ties are to be recommended for spans under 160 feet while double loop ties are recommended for conductors with spans of 160 feet and over.

Utilize preformed conductor ties (TT1) for 3000 lb construction.

Care shall be taken to use the proper length and size tie for each conductor specified in the tables on Page 9-120. Refer to Pages 9-118 thru 9-124 for diagrams and information on Hand Wrapped and Hot Line Ties.

9.5.50 **Types of Ties** –

A. Bridle tie shall be used for all bare and covered conductors larger than #4 AWG regardless of span length.

B. Looped Western Union and Cross Top Tie shall be used for all bare and covered conductors # 4 AWG or smaller (#4, #6,etc.).

C. Bare Conductor – Use bare tie wire. (W22A,W22BA,W22C)

D. Tree Wire – Use covered tie wire (W22D). **Note:** Do **not** use molded plastic ties. Do **not** remove tree wire covering at polyethylene pin type insulator.

E. Existing Polyethylene and Neoprene Covered Line - Wire to be converted to the 15 kV Voltage class – Install 15 kV pin type polyethylene insulator and tie with covered tie wire (W22D) where existing covering on conductor has not been previously removed. Where covering has been removed, use a pin type porcelain insulator and tie conductor to insulator with bare tie wire.

F. Existing Braid Covered (rubber) Line Wire (Maintenance Only) – Remove the covering at the insulators (30 inches on both sides of the insulator) and tie with bare tie wire of the same metal as the line conductor for all voltages.

G. Double insulators shall use ties for single insulators with each tie occupying one-half the available space between insulators – same number of turns with closer spacing.

9.5.60 **Splices, Connectors, Taps, Etc.**

See Section 5 (Connectors) for all information regarding choosing and installing splices, connectors, taps, deadend clamps, etc for bare or covered wire.

Supersedes 7/07 Issue - Removed splice/connector information (refer to Section 5); text shift.

9.5.70 When Voltage Changes Along Line

When two sections of line with different voltages, both 15kV or below, come to the same poles, see page 9-207 for required line isolation by establishment of a de-energized span. This situation will typically occur at locations where a voltage conversion project ends and no tie through a step-down / step-up transformer is established or where line extensions of different voltages meet to serve all customers along a road.

9.6 VOLTAGE CONVERSIONS

All voltage conversions done on the PPL distribution system must be done in accordance with EOP D010 - Primary Circuit/Transformer Voltage Conversion.

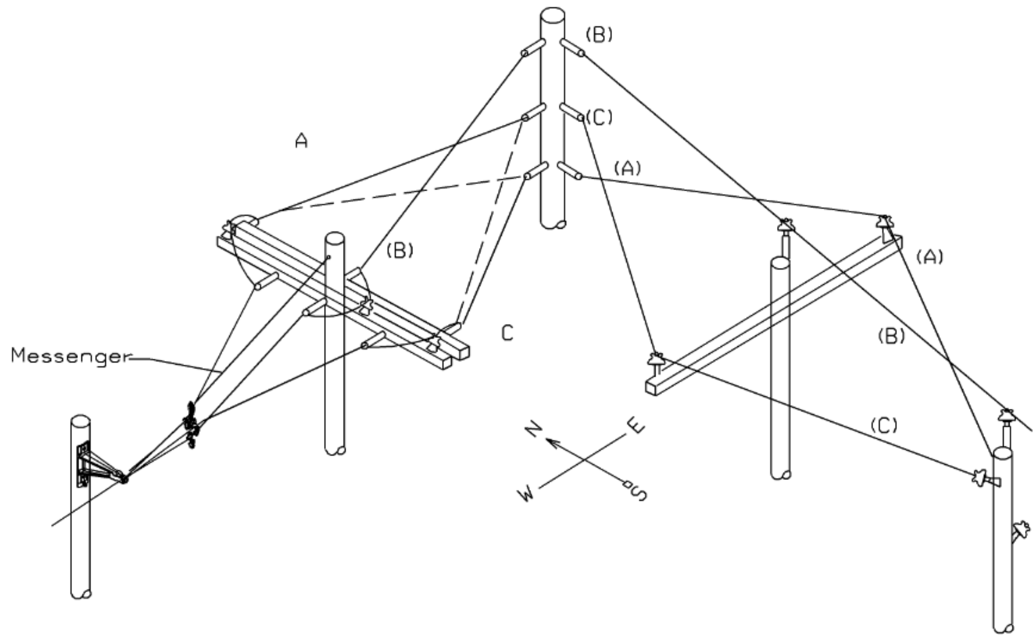
9.6.10 Material Requirements

Certain material items shall be replaced or added during a conversion. These include, but are not limited to, the following:

A. Wood insulator pins must be replaced with steel pins.
B. Correct insulation level must be in place: single bell insulators in deadends and 5kV pin insulators must be replaced.
C. Guy wires must be built to current standards - see Section 3.4.50 (Voltage Conversions) for details.
D. Primary taps shall be fused.
E. Arresters shall be installed per Section 13.6 (Lightning Protection).

Supersedes 7/15 Issue - Added section 9.5.70 requirement for lines of different voltages.

Supersedes 1/06 Issue – 25-35 kV Construction Information is Relocated to New Section 20

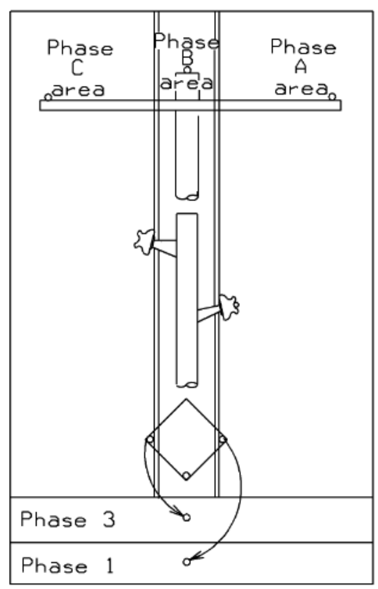


Notes:
If there are local rules that have been approved by the division superintendent, these should be followed where practicable. Otherwise use the rules below:

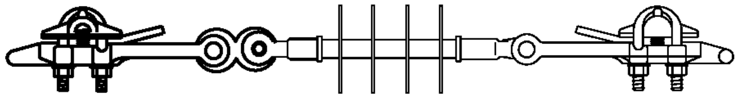
(1) Put phase A on the northerly or easterly side for horizontal crossarm or spacer cable installation. Put phase A on the bottom for vertical construction.

(2) Put phase B in the middle or top positoin for horizontal crossarm or for vertical construction. Phase B shall occupy the middle and bottom position for spacer cable in triangular arrangments.

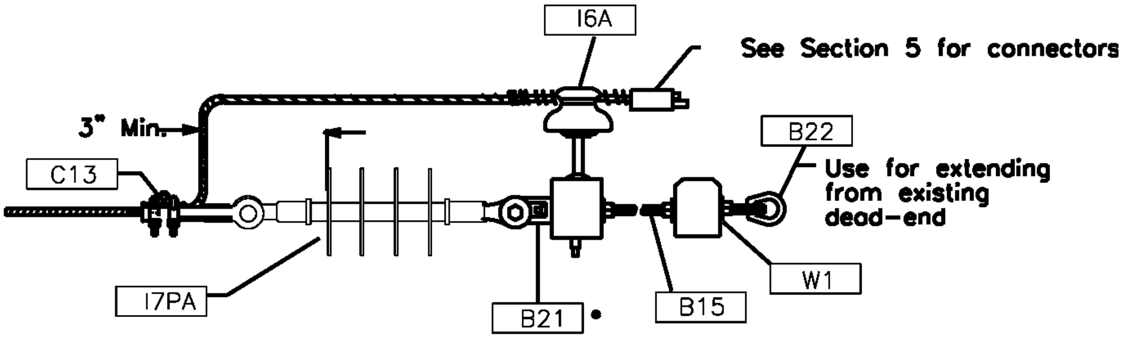
(3) Put phase C in the remaining position.



Look north
Look east
Look west

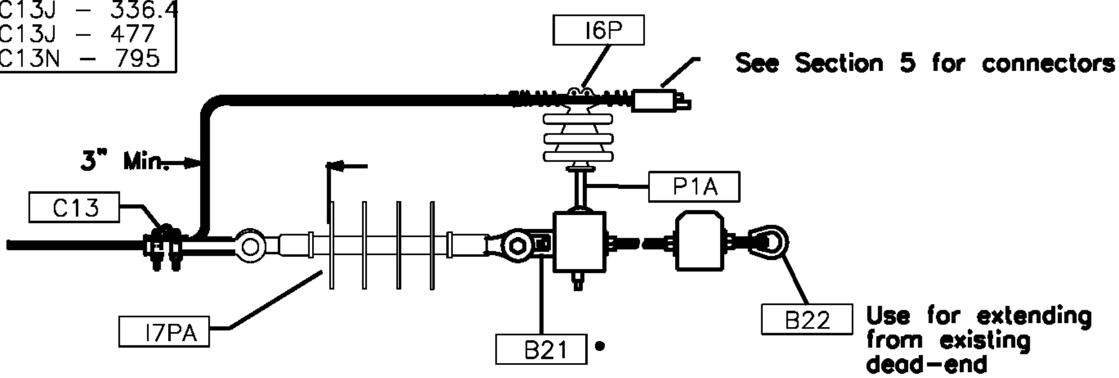


Inline Dead Ends

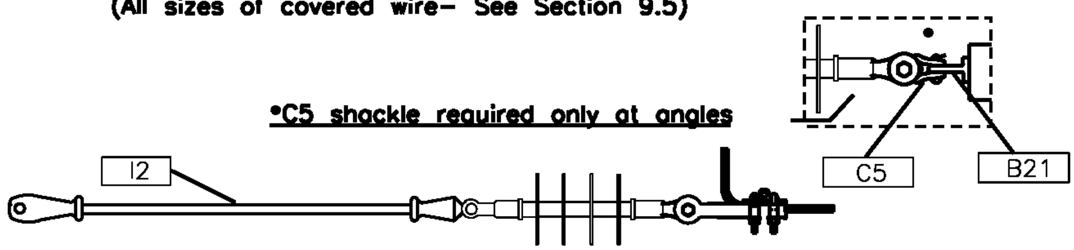


Dead-End Clamps
(All sizes of bare wire)

C13H	1/0
C13J	336.4
C13J	477
C13N	795



Dead-End Clamps
(All sizes of covered wire- See Section 9.5)



Inline Dead Ends

Notes:

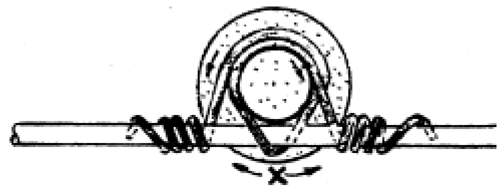
Maintain full impulse and flashover strength; see Section 7.
This drawing is for dead-ends on wood crossarms or wood poles.

See 2.8 for information on crossarm.
Use heavy duty crossarms(C31D) and braces(TB60) and gain plates(C37) for 3000 lb construction.

Supersedes 7/11 Issue – Corrected second and third drawings by removing the figure-8 link.

Supersedes 1/06 Issue – 25-35 kV Construction Information is Relocated to New Section 20

HAND WRAPPED TIES



LOOPED WESTERN UNION (LWU) - SIDE GROOVE TIE
FIG I

CROSS TOP (CT) TOP GROOVE TIE
FIG II

FIG I & II TO BE USED FOR ALL BARE AND COVERED CONDUCTOR OF #4 AWG OR SMALLER.

BRIDLE TIE SIDE GROOVE
FIG III

BRIDLE TIE TOP GROOVE
FIG IV

FIG III & IV TO BE USED ON ALL COPPER & ALUMINUM CONDUCTORS LARGER THAN #4 AWG

TIE CONDUCTORS

TABLE I – LENGTH AND TYPE - FOR BARE LINE CONDUCTOR

Line Conductor Size AWG-kcmil	Tie Wire Size AWG	Std Item	Class 55-4 Insulator – 15kV			
			Side Groove		Top Groove	
			Length (Inches)	Type	Length (Inches)	Type
# 6 Cu	# 6 Cu	W22A	28	LWU	32	CT
# 6A CW &CCW	# 6 Cu	W22A	32	LWU	36	CT
# 4 Cu	# 6 Cu	W22A	38	LWU	40	CT
# 3 Cu	# 6 Cu	W22A	55	Bridle	46	Bridle
# 2 Cu	# 4 Cu	W22BA	62	Bridle	54	Bridle
# 1/0 Cu	# 4 Cu	W22BA	70	Bridle	60	Bridle
# 4/0 Cu	# 4 Cu	W22BA	76	Bridle	64	Bridle
Larger Cu	# 4 Cu	W22BA	-	Bridle	-	-
# 4 ACSR	#4 AL	W22C	38	LWU	40	CT
# 2 ACSR	#4 AL	W22C	62	Bridle	53	Bridle
# 1/0 ACSR	#4 AL	W22C	66	Bridle	56	Bridle
# 4/0 AAC	#4 AL	W22C	78	Bridle	66	Bridle
336.4 AAC	#4 AL	W22C	86	Bridle	74	Bridle
336.4 ACSR3000#	#4 AL	TT1B	Preform	Bridle	Preform	Bridle
477.0 AAC	#4 AL	W22C	105	Bridle	93	Bridle
477.0 ACSR	#4 AL	W22C	105	Bridle	93	Bridle
795 AAC	#4 AL	W22C	108	Bridle	96	Bridle

TABLE II – LENGTH AND TYPE - FOR COVERED AND TREE LINE CONDUCTOR

Note: If insulation is removed 30”, use bare tie wire (see above)

Line Conductor Size AWG-kcmil	Tie Wire Size AWG	Std Item	Class 55-4 Insulator – 15kV			
			Side Groove		Top Groove	
			Length (Inches)	Type	Length (Inches)	Type
# 6 Cu	#4 AL TPR	W22D	28	LWU	32	CT
# 6A CW &CCW	#4 AL TPR	W22D	32	LWU	36	CT
# 4 Cu	#4 AL TPR	W22D	38	LWU	40	CT
# 3 Cu	#4 AL TPR	W22D	38	Bridle	50	Bridle
# 2 Cu	#4 AL TPR	W22D	62	Bridle	54	Bridle
# 1/0 Cu	#4 AL TPR	W22D	68	Bridle	60	Bridle
# 4/0 Cu	#4 AL TPR	W22D	77	Bridle	68	Bridle
Larger Cu	#4 AL TPR	W22D	-	Bridle	-	-
# 4 ACSR	#4 AL TPR	W22D	38	LWU	40	CT
# 2 ACSR	#4 AL TPR	W22D	62	Bridle	53	Bridle
# 1/0 ACSR	#4 AL TPR	W22D	66	Bridle	56	Bridle
# 4/0 AAC	#4 AL TPR	W22D	78	Bridle	66	Bridle
336.4 AAC	#4 AL TPR	W22D	86	Bridle	74	Bridle
477.0 AAC	#4 AL TPR	W22D	105	Bridle	93	Bridle
795 AAC	#4 AL TPR	W22D	108	Bridle	96	Bridle

Supersedes 1/06 Issue – 25-35 kV Construction Information is Relocated to New Section 20

SINGLE LOOP HOT LINE TIES

1. **<u>USE SINGLE LOOP TIES FOR SPANS UNDER 160 FEET</u>**. where lines are to be worked hot. Use double ties for spans over 160 feet. and for all angle poles.

Approx. ¾" Diameter.

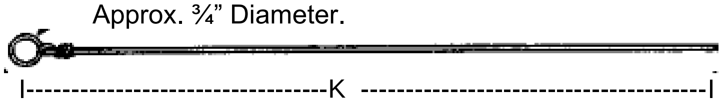


Figure A – Prepare Loop – Two Required

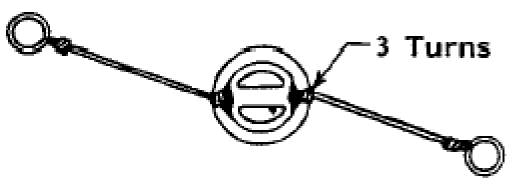


Figure B – Loops In Place On Insulator

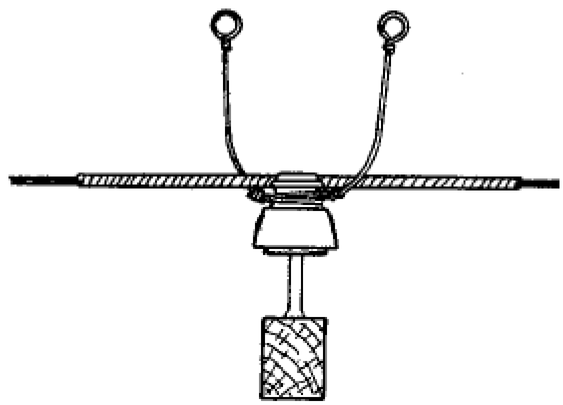


Figure C – Conductor In Place

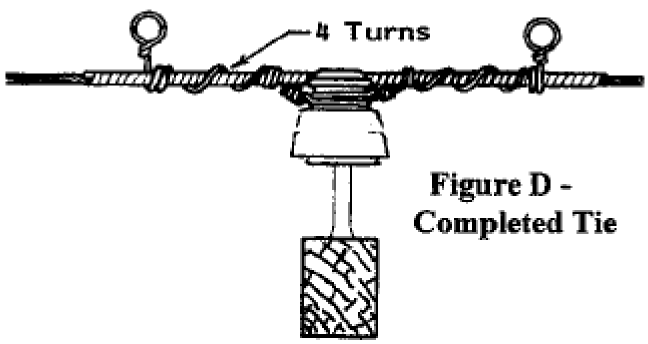


Figure D - Completed Tie

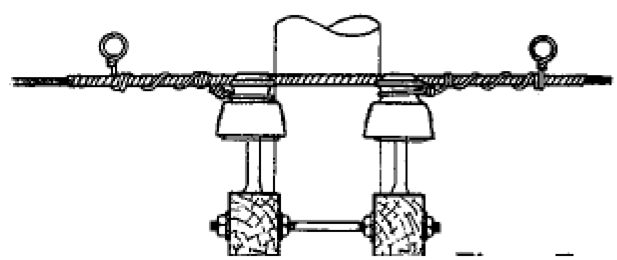


Figure E – On Double Arms

Line Wire Size AWG-kcmil	Tie Wire Size AWG-kcmil	Length "K" (Inches)			Line Wire Size AWG-kcmil	Tie Wire Size AWG-kcmil	Length "K" (Inches)
#3 Copper	#6 Copper	32			#1/0 6201 Al.	#4 Alum.	34
#1/0 Copper	#4 Copper	36			#4/0 6201 Al.	#4 Alum	40
#4/0 Copper	#4 Copper	40			336.4 ECA	#4 Alum	44
#4 ACSR	#4 Alum.	28			477.0 ECA	#4 Alum	46
#1/0 ACSR	#4 Alum.	34					

Supersedes 1/06 Issue – 25-35 kV Construction Information is Relocated to New Section 20

DOUBLE LOOP HOT LINE TIES

1. **<u>USE DOUBLE LOOP TIES FOR SPANS OVER 160 FEET</u>**. where lines are to be worked on hot and for all angle poles. Use single ties for spans under 160 feet.

Approx. ¾" Dia.
2 - Full Turns

Figure A- Prepare Loop – Two Required

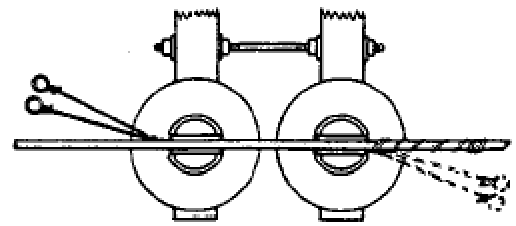


Figure E – Double Insulators Conductor In Place – Top Groove

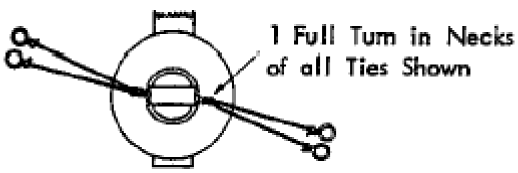


Figure B – Loops In Place On Insulator (Top View)

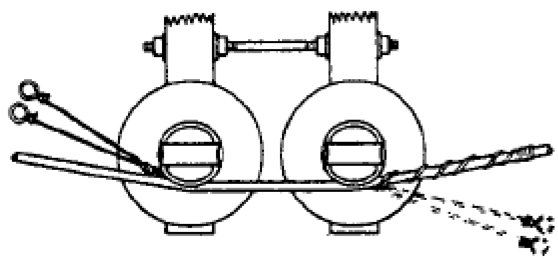


Figure F – Double Insulators Conductor In Place – Side Groove

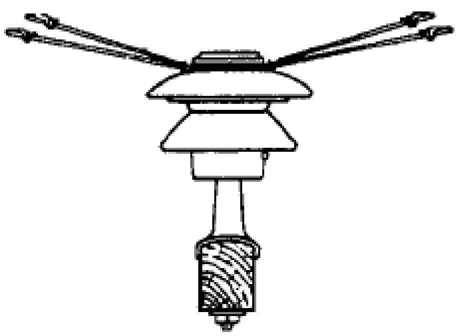


Figure C – Loops In Place On Insulator

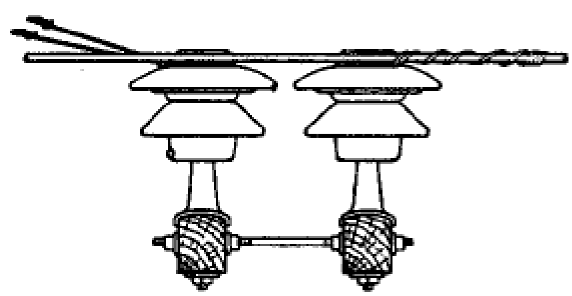


Figure G – Double Insulators Elevation

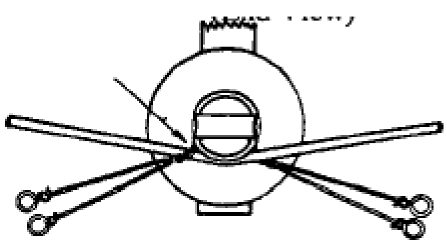


Figure D – Conductor In Place (In Side Groove For Angle In Line)

Supersedes 1/06 Issue – 25-35 kV Construction Information is Relocated to New Section 20

Pole spans are limited primarily by the sag characteristics of the primary conductor relative to the horizontal and vertical separations provided by the standard pole top arrangement. Increases in separations at the pole may permit longer spans. Transverse wind loadings may not allow use of extremely long spans. Maximum spans are determined by the following criteria:

Horizontal Clearance (Distance between Phase Conductors at the same level)

Maximum spans are limited by the HORIZONTAL clearance of the primary conductors outlined in the NESC (National Electrical Safety Code) rule 235B.

The clearance at the supports of conductors shall not be less than the greater of the following:

- The clearance shown here (from NESC Table 235-1):
  - 12" for supply conductors with 0 to 8.7 kV between conductors of the same or different circuits.
  - 15" for supply conductors with 8.7 to 15 kV between conductors of the same or different circuits.
  - See NESC Rule 235B1a and Table 235-1 for other voltages.
- The clearance (in inches) given by one of the following formulas at a conductor temperature of 60°F (15°C), final unloaded sag with no wind:
  - For conductors smaller than AWG #2: $c = (0.3)(V) + 4.04\sqrt{s - 24}$.
  - For conductors of AWG #2 and larger: $= (0.3)(V) + 8\sqrt{\frac{s}{12}}$.

  Where,
  c = horizontal clearance between the primary conductors, in inches,
  V = voltage between the conductors, in kV, and
  s = sag of the conductor having the greater sag, in inches.

Clearances are between conductors located at approximately the same level.

Vertical Clearance (Primary to Secondary or Neutral)

Maximum spans are limited by the VERTICAL clearance between primary and secondary or neutral conductors outlined in NESC Rule 235C and Section 7.11 of these Standards. The separation shown on the pole top drawings in this section maintain the 12 inch minimum mid-span clearance. Clearances between conductors that are directly above and below each other are limited by the sag of the primary conductor and the sag of either secondary or neutral conductors.

A comparison of sags under two different operating conditions must be evaluated and the operating condition requiring the greatest separation at the structure must be used. These conditions are as follows:

- The upper conductor is at final sag at the greater of 120°F (50°C) or the maximum operating temperature for which the line is designed to operate and the lower conductor is at final sag at the same ambient conditions, 50°F (10°C), as the upper conductor without electrical loading, or
- The upper conductor is at final sag at 32°F (0°C)with ½" radial thickness of ice, and the lower conductor is at final sag without electrical or ice loading at the same ambient conditions, 32°F (0°C), as the upper conductor.

Generally, the sag of primary conductor (bare or tree wire) at its maximum operating temperature of 194°F (90°C) is greater than its sag under ice loaded conditions. Generally, the sag of a spacer cable messenger under ice loaded conditions is greater than its sag at its maximum operating temperature of 120°F (590°C). A comparison should, however, be made.

Supersedes 7/11 Issue – Revised Horizontal and Vertical Clearance Calculations.

Primary conductors, bare or tree wire, are designed to limit the maximum conductor operating temperature to 194°F (90°C) with a summer ambient temperature of 100°F (37.7°C) and a winter ambient temperature of 50°F (10°C). The worst case maximum conductor operating temperature clearance condition will occur when the lower conductor, secondary or neutral, is at the winter ambient temperature of 50°F (10°C).

Sag charts for bare and tree wire primary conductors and neutrals is in Section 6-Primary Conductors. Sag charts for secondary wires are in Section 10-Secondaries.

An additional limit on span lengths comes from NESC Rule 235C2b(3). For span lengths in excess of 150', a supply conductor above 750V but less than 50kV shall not sag lower in the span than a straight line joining the points of support of the highest communication cable or conductor when the supply conductor is at a conductor temperature of 60°F (15°C), no wind displacement and final unloaded sag conditions. This requirement must be met whether or not there is a secondary or neutral wire below this primary conductor.

Vertical Clearance (Secondary to Communications)

Maximum spans are limited by the VERTICAL clearance between secondary or neutral conductors and communication conductors outlined in NESC Rule 235C and Section 7.11 of these Standards. The separation shown on the pole top drawings in this section maintain the 30 inch minimum mid-span clearance. Clearances between conductors that are above and below each other and are limited by the sag of the secondary or neutral conductors and the sag of the communication conductors.

A comparison of sags under two different operating conditions must be evaluated and the operating condition requiring the greatest separation at the structure must be used. These conditions are as follows:

- The upper conductor is at final sag at the greater of 120°F (50°C) or the maximum operating temperature for which the line is designed to operate and the lower conductor is at final sag at the same ambient conditions, 50°F (10°C), as the upper conductor without electrical loading, or

- The upper conductor is at final sag at 32°F (0°C) with ½" radial thickness of ice, and the lower conductor is at final sag without electrical or ice loading at the same ambient conditions, 32°F (0°C), as the upper conductor.

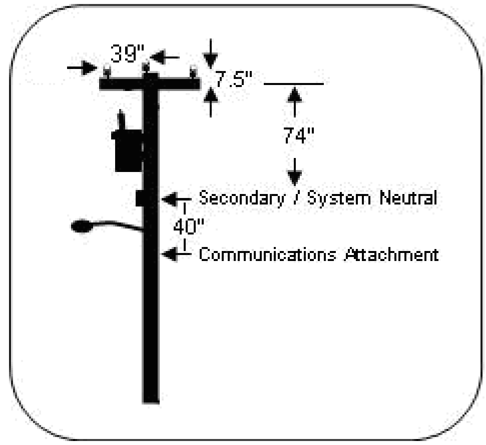
Generally, for secondary triplex or quadplex, the sag under ice loaded condition is greater than the sag at 120°F (50°C), the maximum operating temperature of the supporting neutral. A comparison should, however, be made.

Supersedes 7/11 Issue – Revised Horizontal and Vertical Clearance Calculations.

EXAMPLE CALCULATION – MAXIMUM SPANS

Given:

15 kV class construction
Primary Voltage – 15kV effectively grounded
Pole Framed to 9-411A
Grade C construction
1 – 40 ft., class 3 wood pole JT NE (84" Allocated)
3 – 477 kcmil AAC bare conductors (W21BA)
1/0 AAAC triplex secondary cable (W15C)
Ø to Ø Primary Horizontal Separation = 39" (9-206)
Vertical Pole Spacing (74"+8" = 82")
(8" = thru bolt of xarm to conductor on top of insulator)
40" Spacing (Bottom Secondary Bracket to top of comm.)
For 300' Ruling Span
477 - Sag @ 60°F final, no wind, no ice = 114.40" (6-114).
For 135' Span*
477 - Sag @ 194°F final, no wind, no ice = 50"
1/0 Triplex - Sag @ 50°F final, no wind, no ice = 11"
* = Calculated Values (Steps 5-7)



Supersedes 7/11 Issue – Revised tHorizontal and Vertical Clearance Calculations.

Maximum Span Based on Horizontal Separations Between Primary Conductors: Steps 1-2

Step	Action	Use
1	Determine maximum primary conductor sag based on 39" horizontal separation between primary conductors (see Page 9-200).	From above for #2 AWG and greater: $c = (0.3)(V) + 8\sqrt{\frac{s}{12}}$ where, s = Sag (inches) = unknown c = Primary phase to phase separation (inches) = 39" V = Circuit voltage, phase-to-phase (kV) = 15kV Therefore, $s = 12 * \left(\frac{c-0.3V}{8}\right)^2$ and $s = 12 * \left(\frac{39-0.3(15)}{8}\right)^2$ $s = 223.2"$

Step	Action	Use
2	Determine the maximum span based on maximum primary conductor sag of 223" for 477kcmil AAC Bare Conductor.	$s_m = s_r * \left(\frac{L_m^2}{L_r^2}\right)$ Where, s_m = Maximum sag determined in Step 1 (inches) = 223.2" s_r = Ruling span sag (inches) = 114.4" L_m = Maximum span (feet) = unknown L_r = Ruling span (feet) = 300' Therefore, $L_m = L_r * \sqrt{\frac{s_m}{s_r}}$ and $L_m = L_r * \sqrt{\frac{s_m}{s_r}}$ $L_m = 300 * \sqrt{\frac{223.2}{114.4}}$ $L_m = 420'$

Determine Sag of Actual Span versus Ruling Span: Steps 3-7

Step	Action	Use
3	Determine Sags in "Other Span". (135' span)	$S_a = S_r * \left(\frac{L_a^2}{L_r^2}\right)$ Where, S_a = Sag of Actual Span (inches) S_r = Sag of Ruling Span (inches) L_a = Length of Actual Span (feet) L_r = Length of Ruling Span (feet)
4	Calculate sag for 135' span - 477 Sag @ 194°F (90°C) Final Unloaded (See 6-114)	S_a = Sag of Actual Span = Unknown S_r = Sag of Ruling Span = 42.96" (125' Ruling span) L_a = Length of Actual Span = 135' L_r = Length of Ruling Span = 125' $S_a = S_r * \left(\frac{L_a^2}{L_r^2}\right)$ $S_a = 42.96 * \left(\frac{135^2}{125^2}\right)$ $S_a = 50"$

Supersedes 7/11 Issue –Revised Horizontal and Vertical Clearance Calculations.

Supersedes 7/18 Issue – Corrected ruling span length and table reference in step 5.

Step	Action	Use
5	Calculate sag for 135' span - 1/0 Triplex Sag @ 50°F (10°C), unloaded, initial (See 10-5) Sag @ 32°F (0°C) , ½" ice, final (See 10-5)	S_a = Sag of Actual Span = Unknown L_a = Length of Actual Span = 135' L_r = Length of Ruling Span = 150' S_r = Sag of Ruling Span = 13" (150' Ruling span) $S_a = S_r * \left(\frac{L_a^2}{L_r^2}\right)$ $S_a = 13 * \left(\frac{135^2}{150^2}\right)$ $S_a = 11''$ S_r = Sag of Ruling Span = 13" (150' Ruling span) $S_a = S_r * \left(\frac{L_a^2}{L_r^2}\right)$ $S_a = 31 * \left(\frac{135^2}{150^2}\right)$ $S_a = 25''$

Maximum Span Based on Vertical Separations between Primary, Secondary and Communication Conductors: Steps 8-10

Step	Action	Use
6	Calculate mid-span separation between primary and secondary	Vertical Spacing at Pole Primary to center of crossarm 8" Center of crossarm to secondary + 74" Total 82" Primary Conductor Sag - 50" Secondary Conductor Sag + 11" Mid-span vertical separation between primary and secondary 43" (12" minimum required per Section 7)
7	Calculate mid-span separation between secondary and communications	Vertical Spacing at Pole Secondary to communications 42" (40" + 2" from Sec cond to bottom of Sec Bracket) Secondary Conductor Sag - 25" Mid-span vertical separation between secondary and communications 17" (30" minimum required per Section 7) Note 1: To meet the required 30" mid-span clearance, the vertical spacing at the pole between secondary and communications would need to be increased to 55". Note 2: This calculation is conservative because it makes no allowance for communications cable sag. If the communications cable sag is known, it may be accounted for as the secondary sag is accounted for in Step 7 above.

Determine Clearance between Sagged Primary Conductor and Communication's In-Line-of-Site (>150' & >750V NESC Rule 235C.2b.3): Steps 11-12

Step	Action	Use
8	Check whether sagged primary conductor is above or below communications line-of-sight.	Vertical Spacing at Pole Primary to center of crossarm 8” Center of crossarm to secondary 74” Secondary to communications + 55” Total 137” Primary Conductor Sag - 50” Sagged primary conductor **above** comm. line-of-sight 87” (0” minimum required per Section 7) Note: This NESC rule applies only for spans greater than 150’. The calculation is shown here as an example even though this span is less than 150’.

Conclusions:

Horizontal Clearances – The horizontal clearance of 39” will allow a maximum span of up to 420’ for 477 Bare AAC before mid span contact becomes an issue between primary conductors. This calculated value, per NESC guidelines, is well beyond the span of 135’ in the above example. (Steps 1 - 4)

Vertical Clearances – There are several vertical clearances that need to be evaluated regarding maximum spans. They are as follows:

` Primary to Secondary – The vertical mid-span clearance between the primary and secondary conductor was calculated to be 43” for a span of 135’ in the above example. The NESC minimum clearance shown in Section 7, Page 7-19 indicates 12” is the minimum required at mid span. Therefore, mid span contact between primary and the conductor in the secondary position is not an issue in the above example. (Steps 6 & 7)

Secondary to Communications

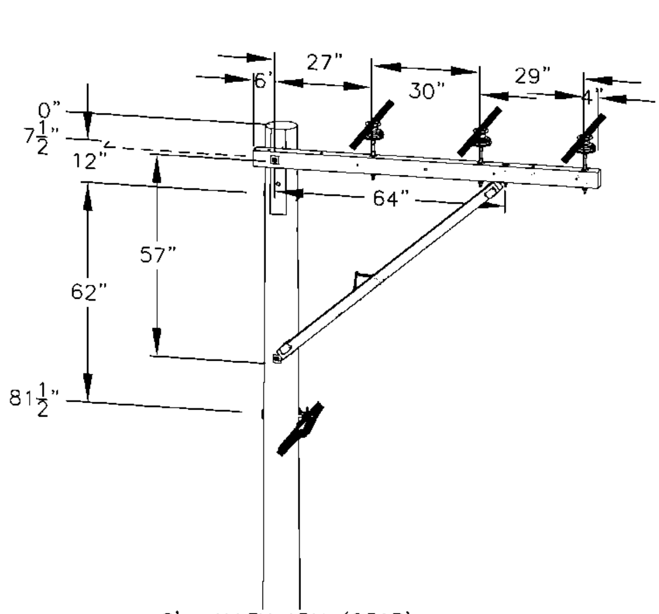
Span Requirements: The span of 135’ will not allow a vertical mid-span clearance of 30” between the secondary conductor (#1/0 Triplex) and the communications cable. This span can only be accommodated by increasing the at-pole separation between the secondary and communications by: (i) installing a taller pole, (ii) raising the secondary bracket to the minimum dimensions indicated in drawing (9-411A), (iii) requesting the communications company to lower their cable, or (iv) having the communications company sag their cable following the sag of the secondary conductor in the secondary position maintaining 30” mid span clearance.

Ice Loaded Conditions: Sag information for Conductors in the Secondary Position should be shared with the various Communication Companies to assist them in evaluating their cable sag requirements to meet NESC codes. Both Electric and Communication companies are allocated their attachment space on poles; however, a mid span clearance of 30” must be maintained when ice loading conditions occur. (See Section 7)

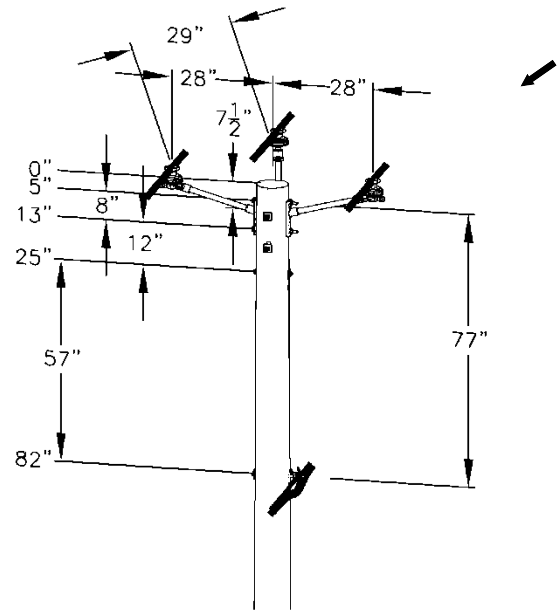
Maximum spans are also limited by pole, crossarm, pin and insulator loadings and strengths. See Section 2.

Supersedes 7/11 Issue – Revised Horizontal and Vertical Clearance Calculations.

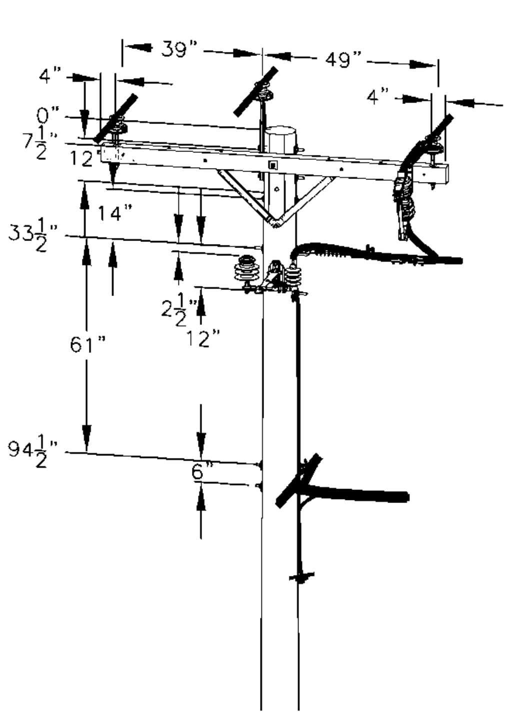
Supersedes 7/11 Issue – Update drawing with a 3-D rendering.



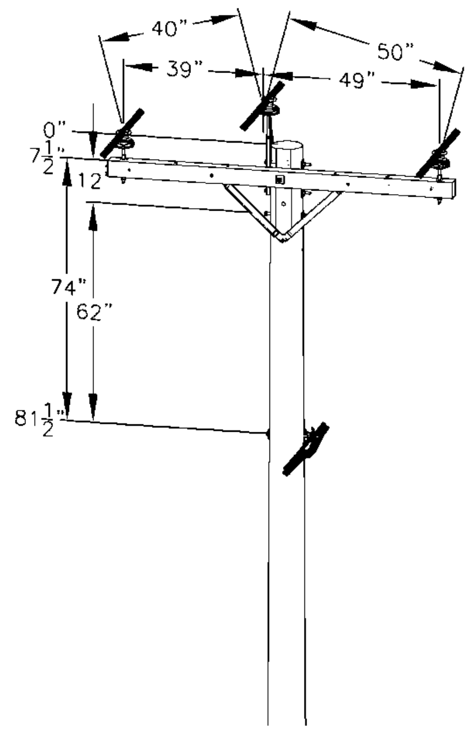
8'- ALLEY ARM (C31B)
(DWG. 9-437)



ARMLESS TANGENT OR ANGLE
(DWG. 9-812)

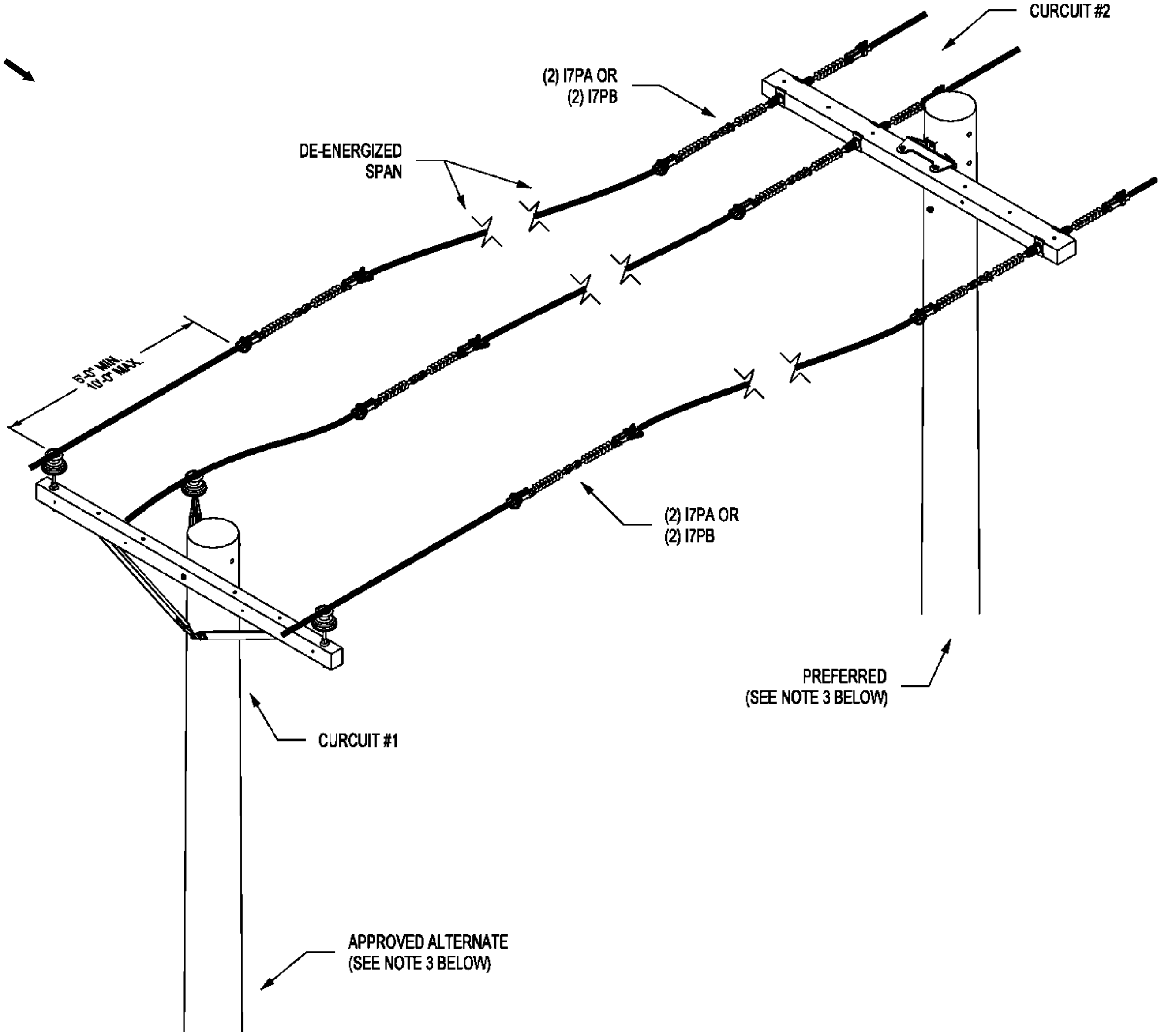


8'- DOUBLE CROSSARM (C31B)
DEADEND WITH TAP
(DWG. 9-419F1, 9-419F2)



8'- CROSSARM (C31B)
TANGENT
(DWG. 9-411)

NOTE:
-THESE DIMENSIONS ARE SHOWN AS GENERAL INFORMATION FOR STANDARD POLE TOPS USING STANDARD MATERIALS. REFER TO SECTION 9 PRIMARY DRAWINGS FOR OTHER ARRANGEMENTS.

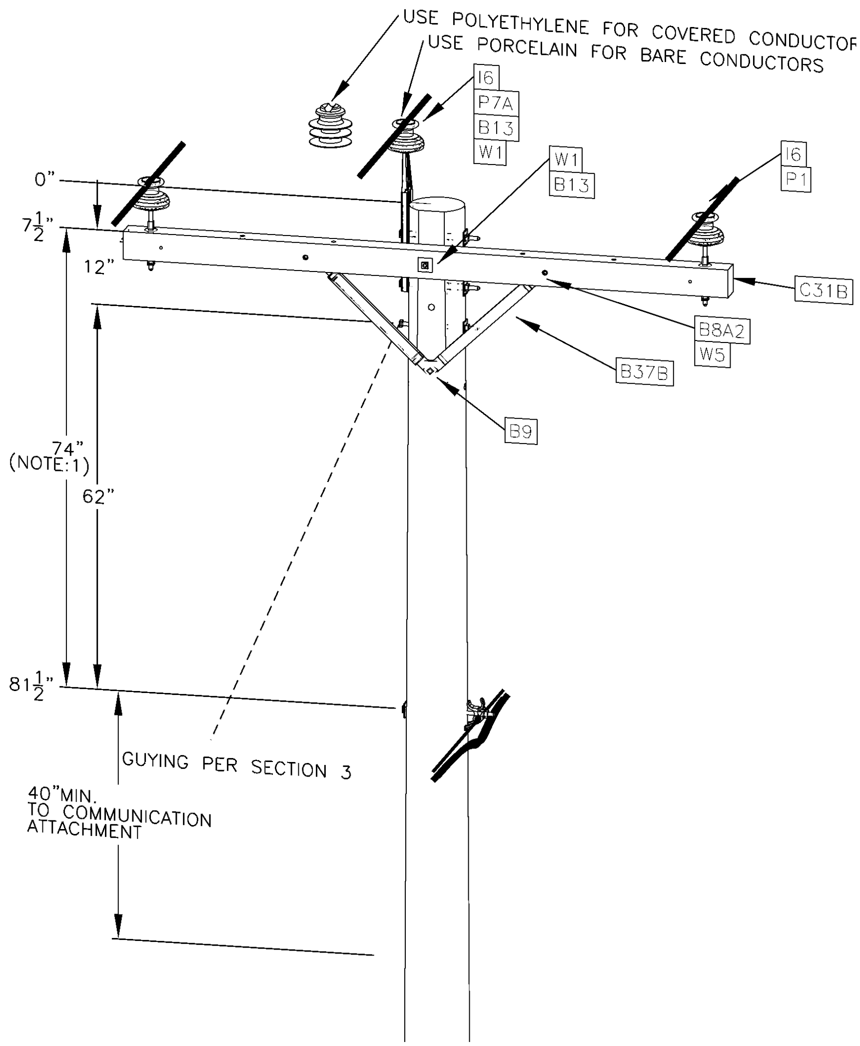


New page.

NOTES:

1. Install a de-energized span between circuits of different voltages. Do not connect the span conductors to either circuit. Do not ground span.
2. Use two polymer deadend insulators at either end of de-energized span. Use insulators appropriate for the higher voltage circuit at both ends.
3. Preferred construction for both ends of the de-energized span is to deadend the line conductors to a fiberglass deadend crossarm (see structure at right in figure above). A nonpreferred alternate is to installation double in-line insulators (see structure at left above). This alternate is allowed only when the conductors for both circuits are the same and deadending conductors to a crossarm is impractical.

MU = @9-411A	0-15KV 3Φ - Bare	MU = @9-411ACL	0-15KV 3Φ - Covered
MU = @9-411B	0-15KV 1Φ - Bare	MU = @9-411BCL	0-15KV 1Φ - Covered



Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

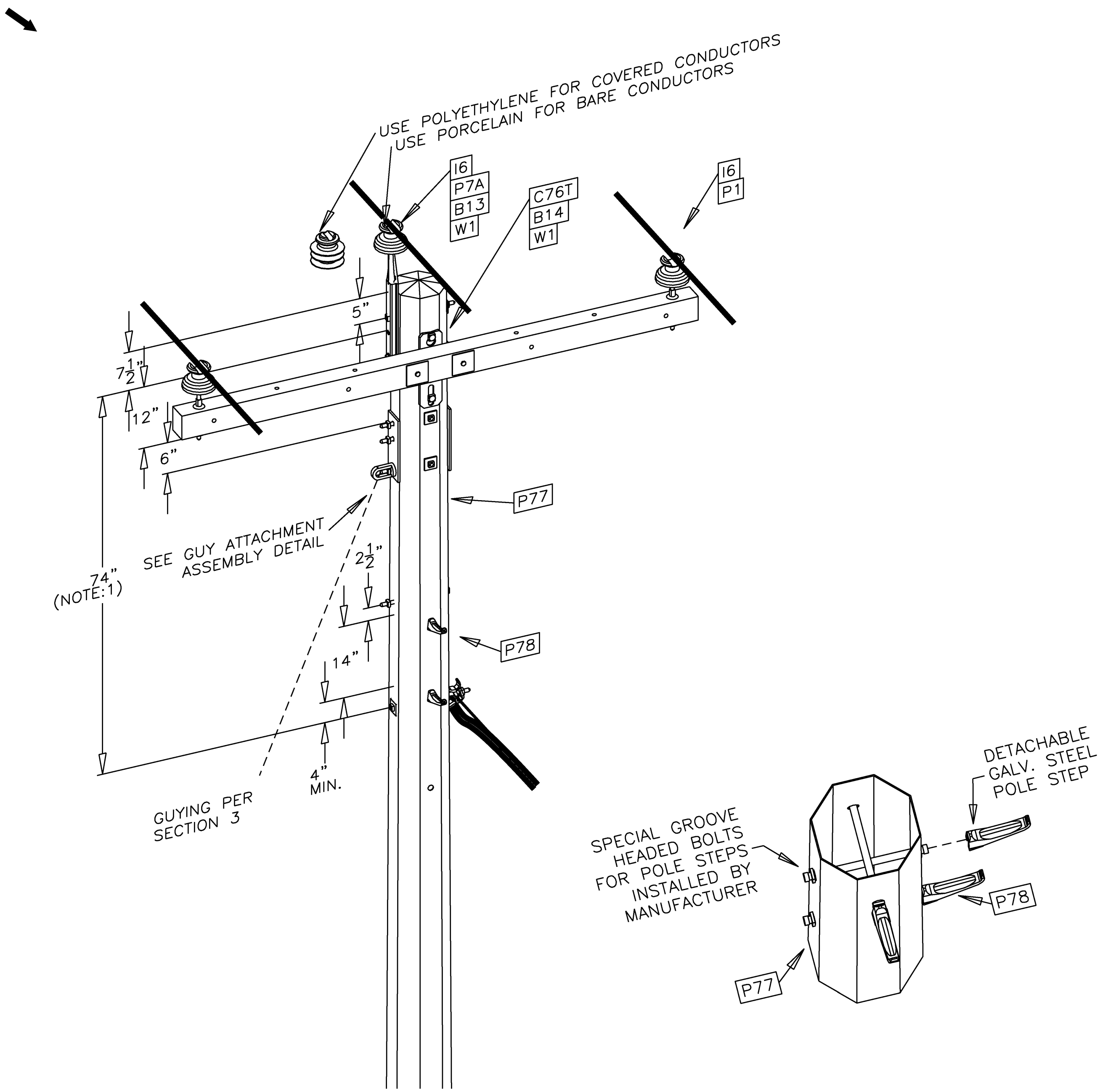
SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES

1. This clearance can be reduced to a minimum of 48” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta circuit construction, omit the center phase.

1Φ (DELTA) AND 3Φ CROSSARM POLE TOP – 0-15 kV 0˚ - 10˚			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER: 9-411	ISSUE: 7/16

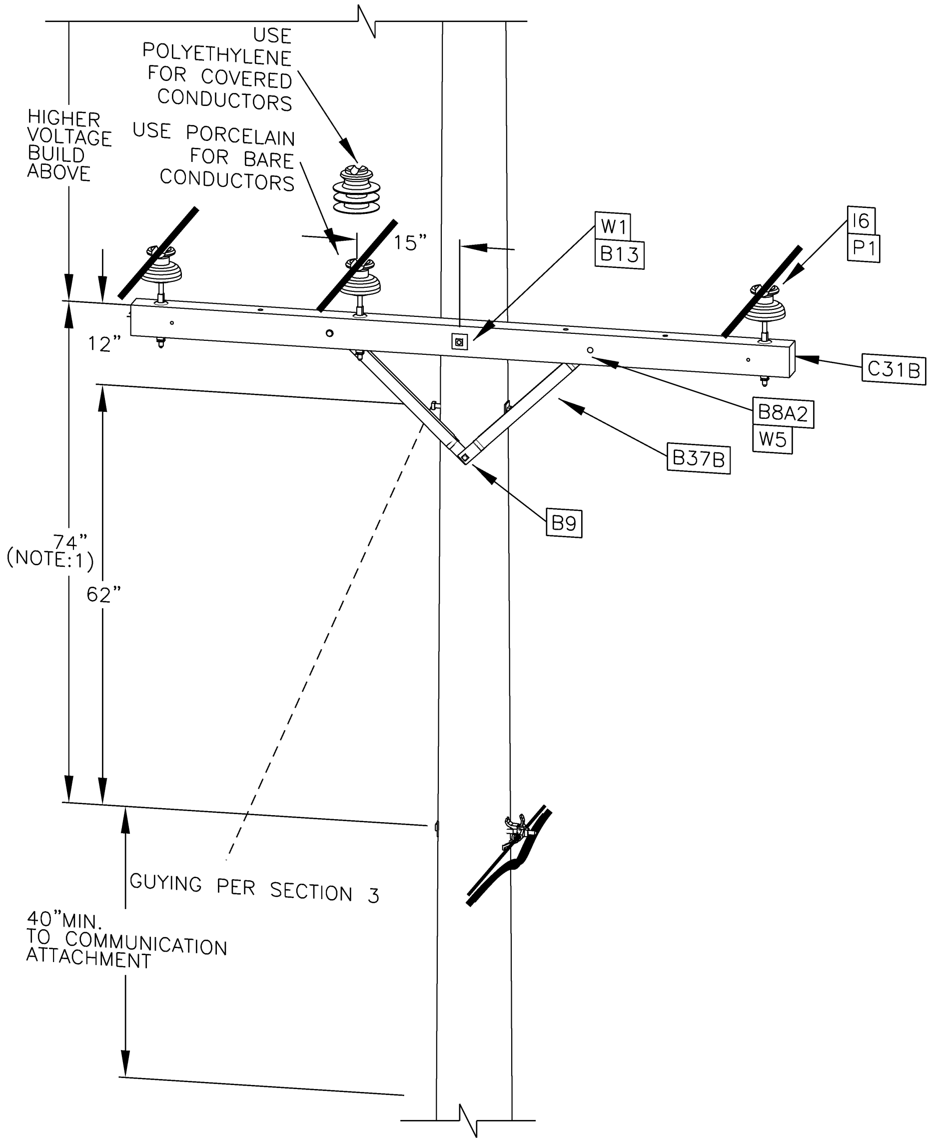
MU = @9-411AF	0-15KV 3Φ - Bare	MU = @9-411AFCL	0-15KV 3Φ - Covered
MU = @9-411BF	0-15KV 1Φ - Bare	MU = @9-411BFCL	0-15KV 1Φ - Covered



Supersedes 7161 Issue – Replaced guying detail with reference to Section for guying information.

NOTES:

1. This clearance can be reduced to a minimum of 52” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. Detachable steel pole steps maybe left installed while maintaining an 8 foot minimum from ground level.
3. If grounding is necessary, install down ground & molding with appropriate grounding kit (Std Item S34) which includes nylon clips and self tapping screws. Place clips approximately 12”-18” apart.
4. Install 12.5M maximum guy wire. If 25M is required, install 2 separate 12.5M guys.
5. For single phase delta circuit construction, omit the center phase.



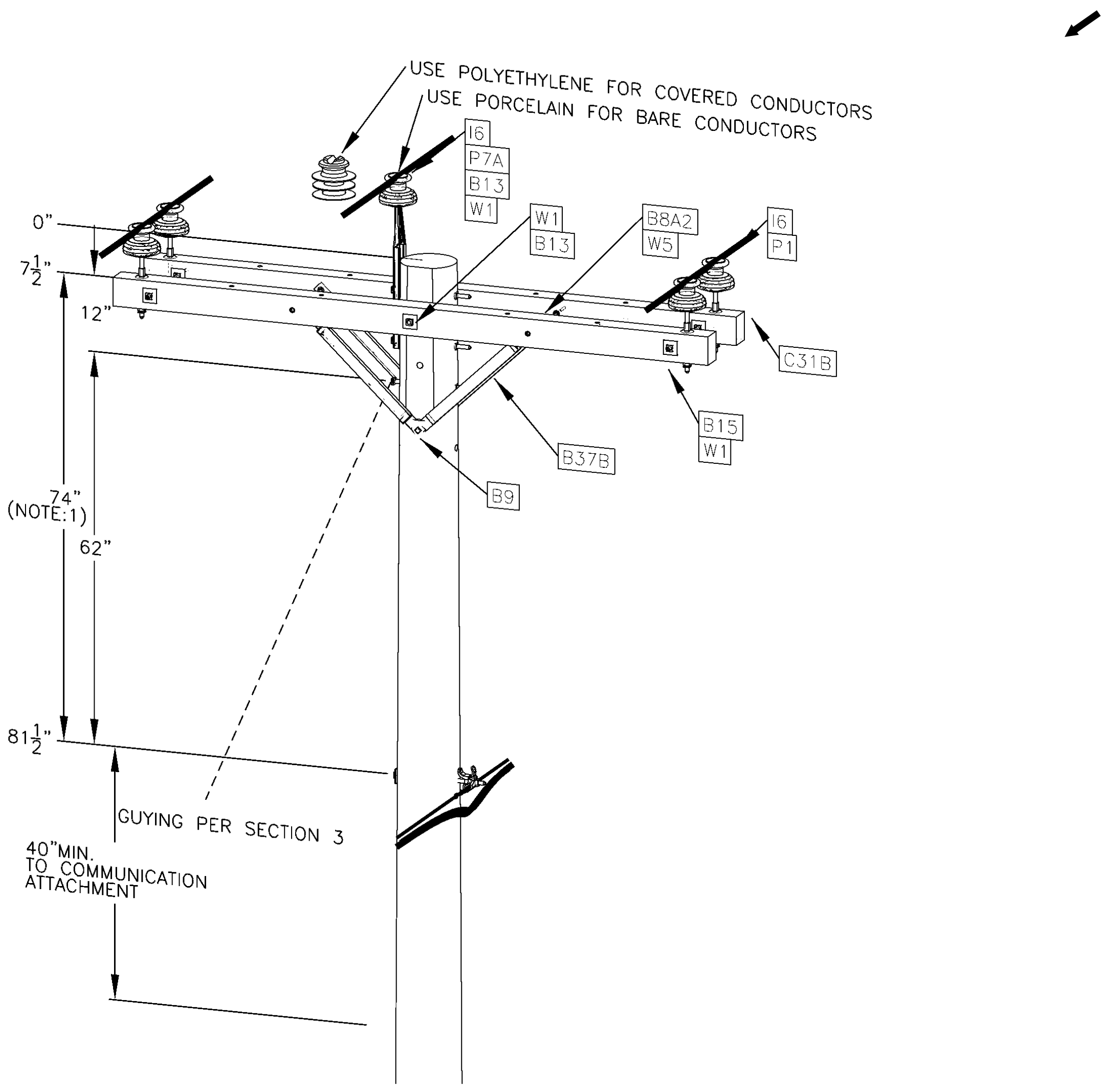
New Page 7/19.

NOTES

1. This clearance can be reduced to a minimum of 48" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

MU = @9-412A	0-15KV 3Φ - Bare	MU = @9-412ACL	0-15KV 3Φ - Covered
MU = @9-412B	0-15KV 1Φ - Bare	MU = @9-412BCL	0-15KV 1Φ - Covered

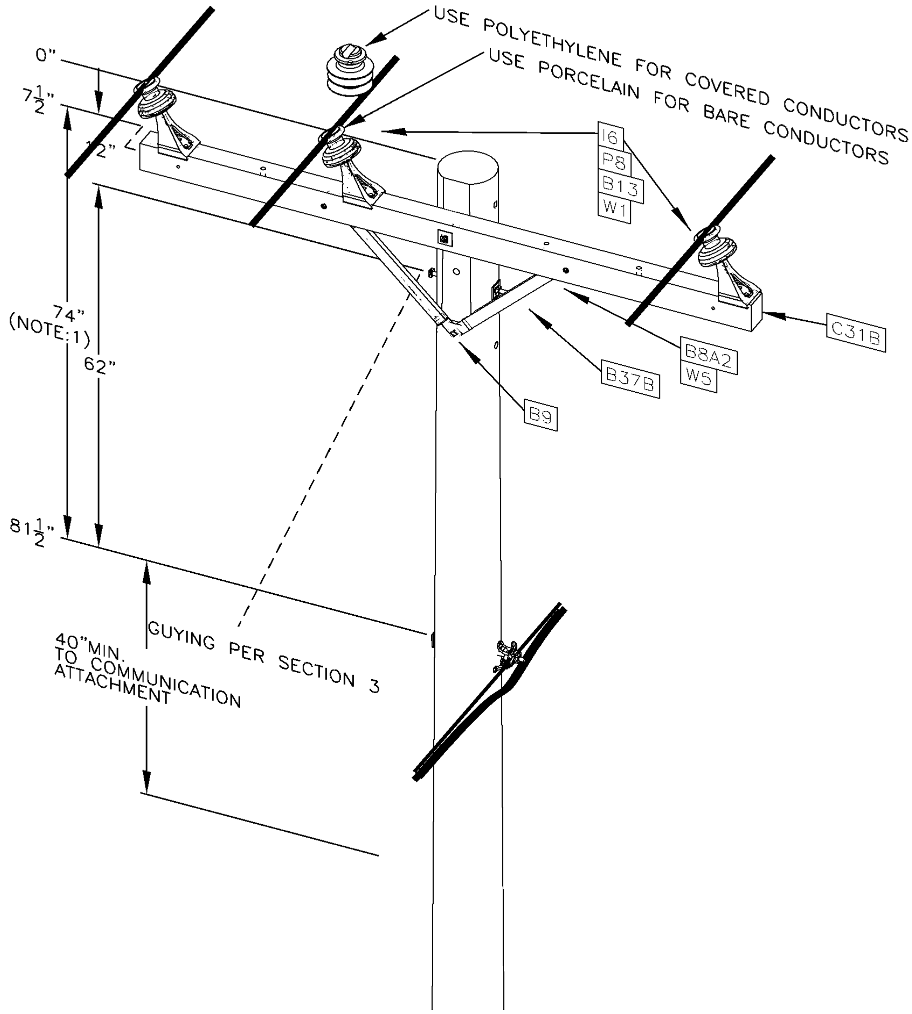
Supersedes 7/11 Issue – Update drawing with a 3-D rendering.



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES

1. This clearance can be reduced to a minimum of 48” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta circuit construction, omit the center phase.



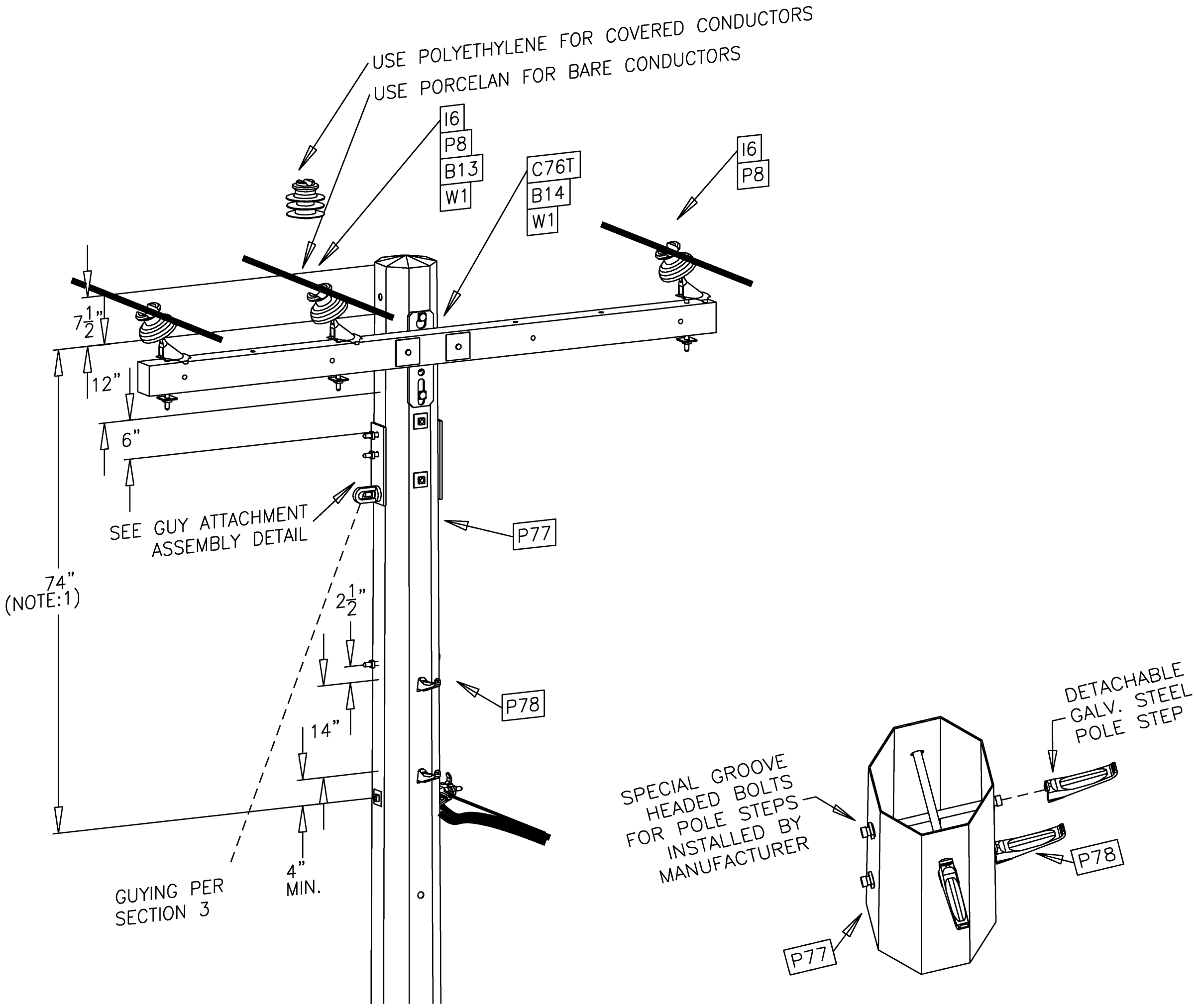
Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES

1. This clearance can be reduced to a minimum of 48” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta circuit construction, omit the center phase.

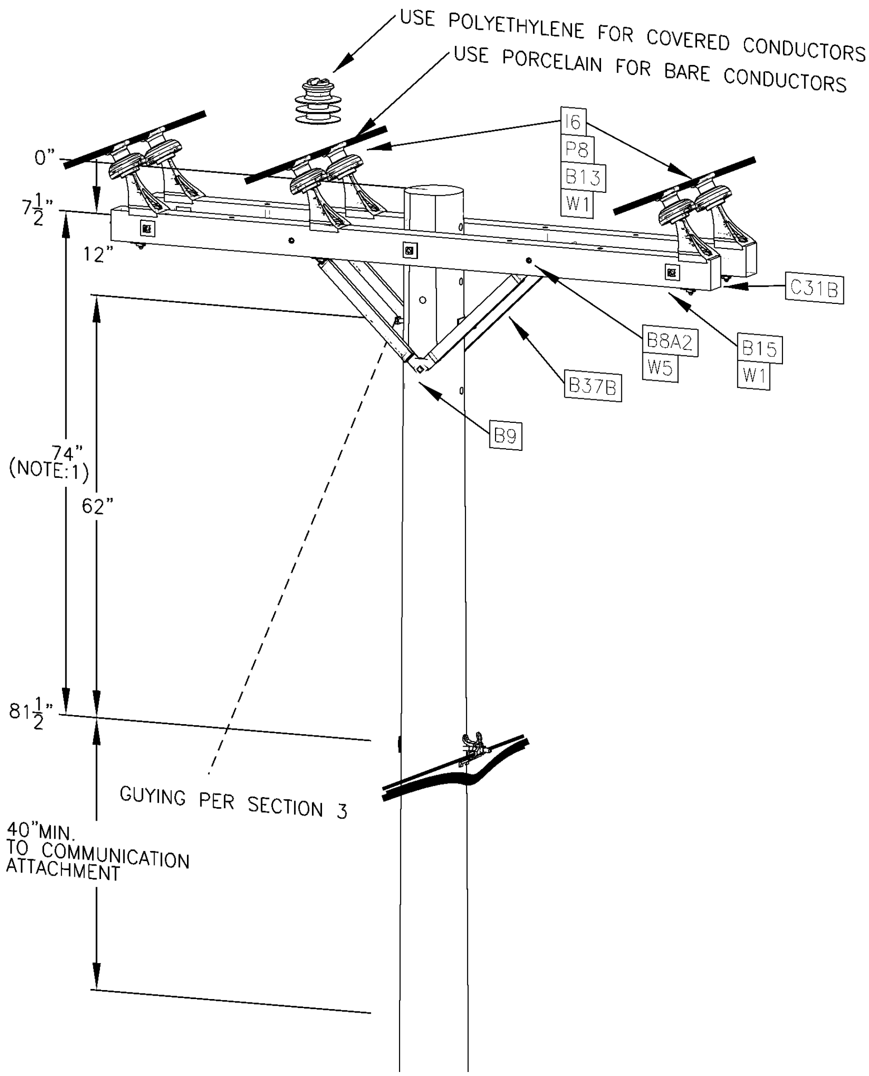
MU = @9-413AF	0-15KV 3Φ - Bare	MU = @9-413AFCL	0-15KV 3Φ - Covered
MU = @9-413BF	0-15KV 1Φ - Bare	MU = @9-413BFCL	0-15KV 1Φ - Covered



NOTES:

1. This clearance can be reduced to a minimum of 52” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. Detachable steel pole steps maybe left installed while maintaining an 8 foot minimum from ground level.
3. If grounding is necessary, install down ground & molding with appropriate grounding kit (Std Item S34) which includes nylon clips and self tapping screws. Place clips approximately 12”-18” apart.
4. Install 12.5M maximum guy wire. If 25M is required, install 2 separate 12.5M guys.
5. For single phase delta circuit construction, omit the center phase.

MU = @9-414A	0-15KV 3Φ - Bare	MU = @9-414ACL	0-15KV 3Φ - Covered
MU = @9-414B	0-15KV 1Φ - Bare	MU = @9-414BCL	0-15KV 1Φ - Covered



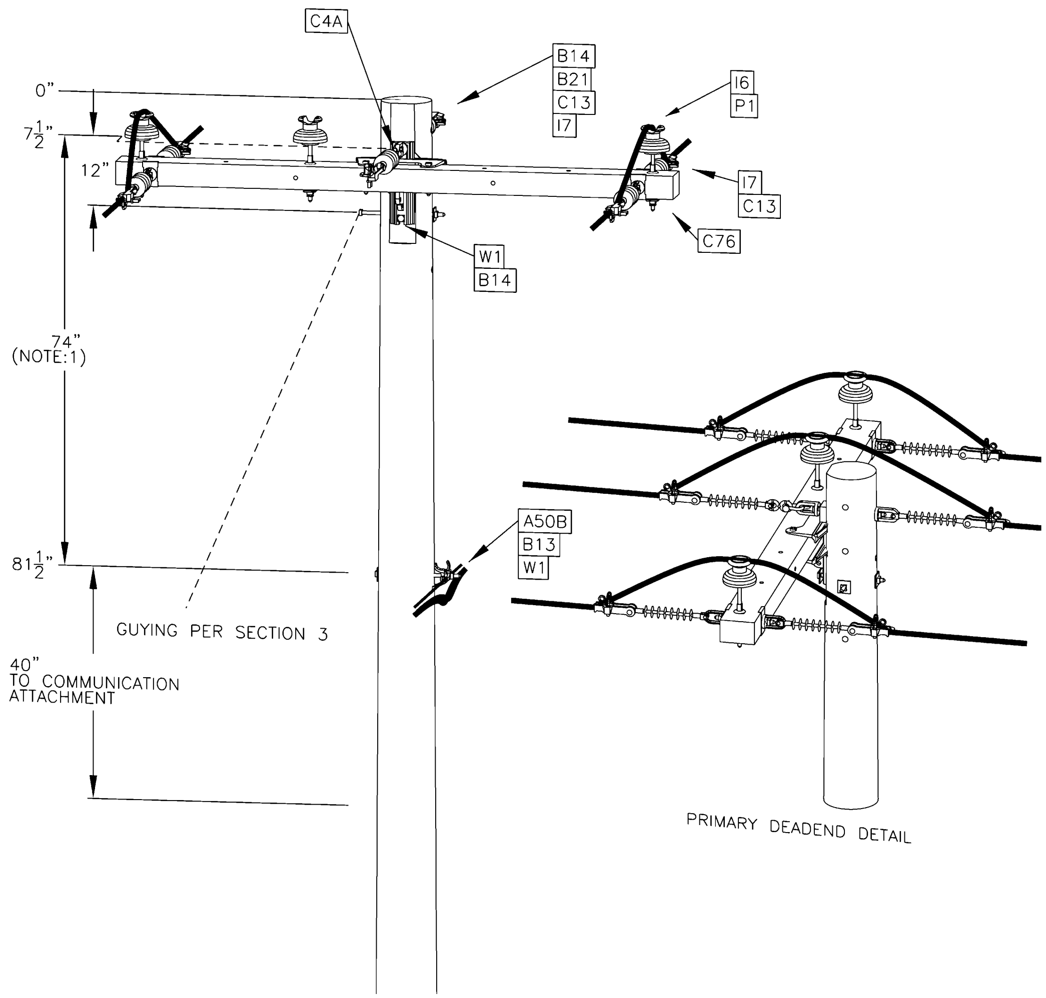
Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES

1. This clearance can be reduced to a minimum of 48” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta circuit construction, omit the center phase.

MU = @9-415A	0-15KV 3Φ - Bare	MU = @9-415ACL	0-15KV 3Φ - Covered
MU = @9-415B	0-15KV 1Φ - Bare	MU = @9-415BCL	0-15KV 1Φ - Covered



Supersedes 7/16 Issue – Modified center string attachment.

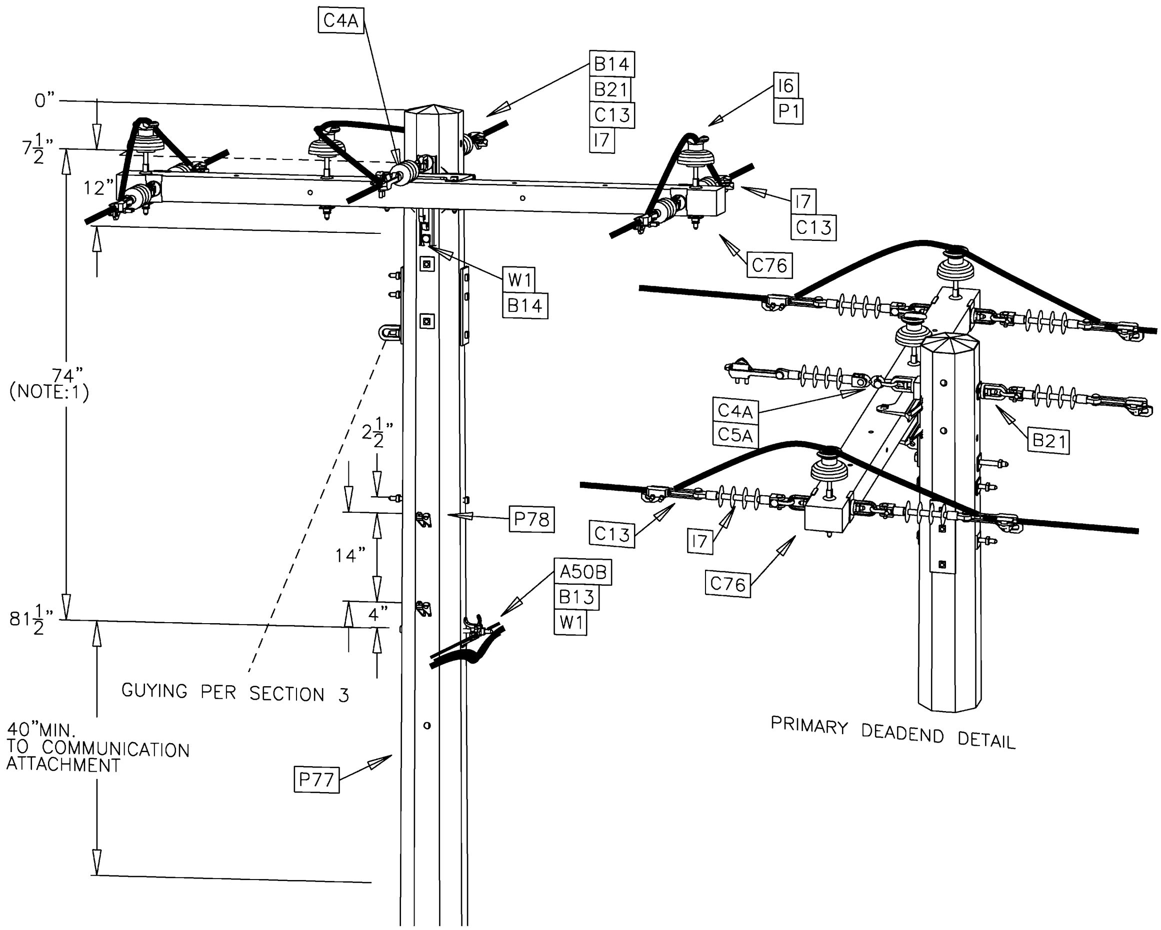
SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	45 JT-111"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	45 JT-111"	255	185	175
86	45 JT-111"	300	--	--
106	45 JT-111"	--	240	--
107	45 JT-111"	--	--	225
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

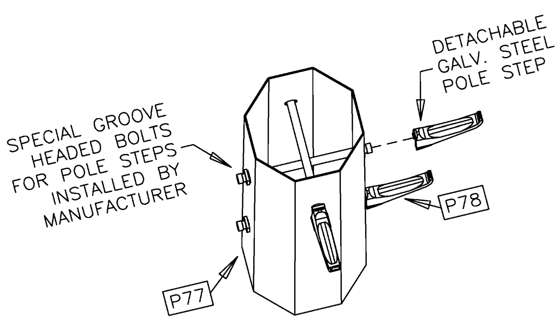
NOTES

1. This clearance can be reduced to a minimum of 56" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta circuit construction, omit the center phase.

1Φ (DELTA) AND 3Φ DEADEND CROSSARM POLE TOP – 0-15 kV
46° - 60° ANGLES / BACK-TO-BACK DEADENDS (TANGENT)

MU = @9-415AF	0-15KV 3Φ - Bare	MU = @9-415AFCL	0-15KV 3Φ - Covered
MU = @9-415BF	0-15KV 1Φ - Bare	MU = @9-415BFCL	0-15KV 1Φ - Covered



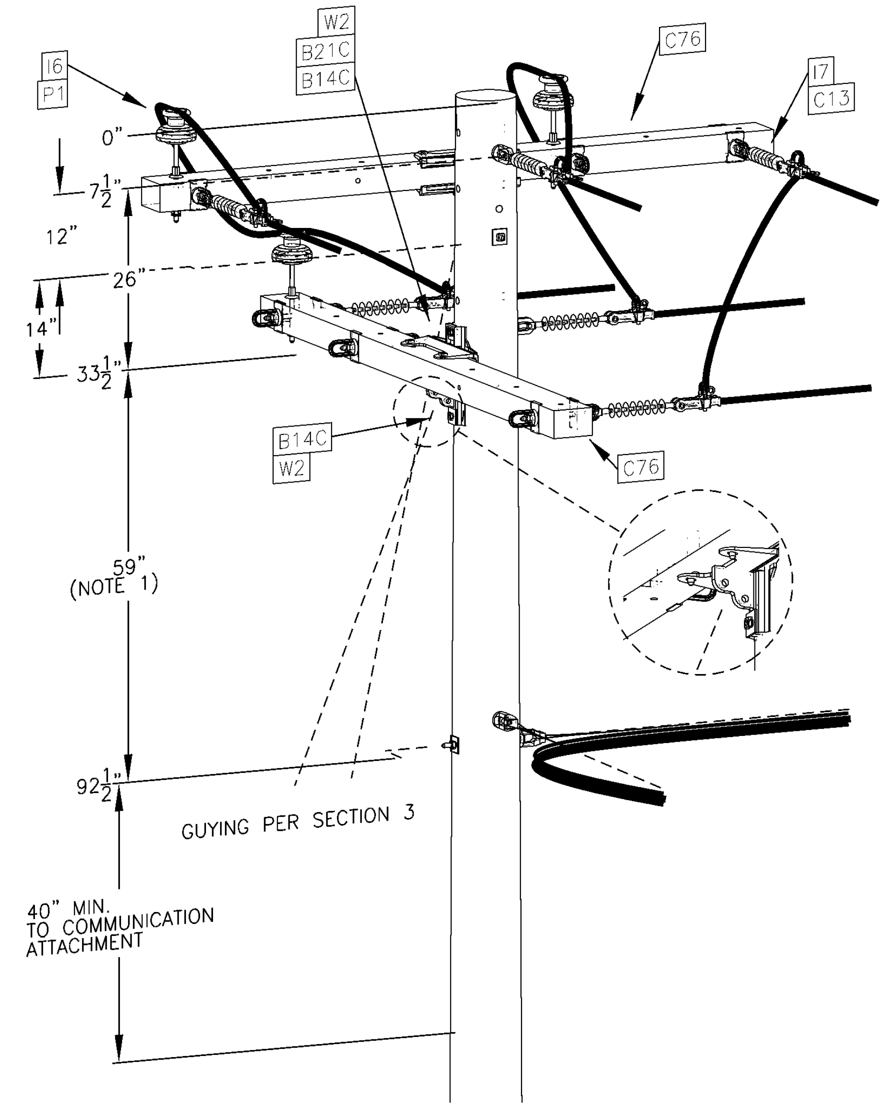


NOTES:

1. This clearance can be reduced to a minimum of 60" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. Detachable steel pole steps maybe left installed while maintaining an 8 foot minimum from ground level.
3. If grounding is necessary, install down ground & molding with appropriate grounding kit (Std Item S34) which includes nylon clips and self tapping screws. Place clips approximately 12"-18" apart.
4. Install 12.5M maximum guy wire. If 25M is required, install 2 separate 12.5M guys.
5. For single phase delta circuit construction, omit the center phase.

MU = @9-416A	0-15KV 3Φ - Bare	MU = @9-416ACL	0-15KV 3Φ - Covered
MU = @9-416B	0-15KV 1Φ - Bare	MU = @9-416BCL	0-15KV 1Φ - Covered

Supersedes 7/14 Issue – Update drawing with a 3-D rendering.



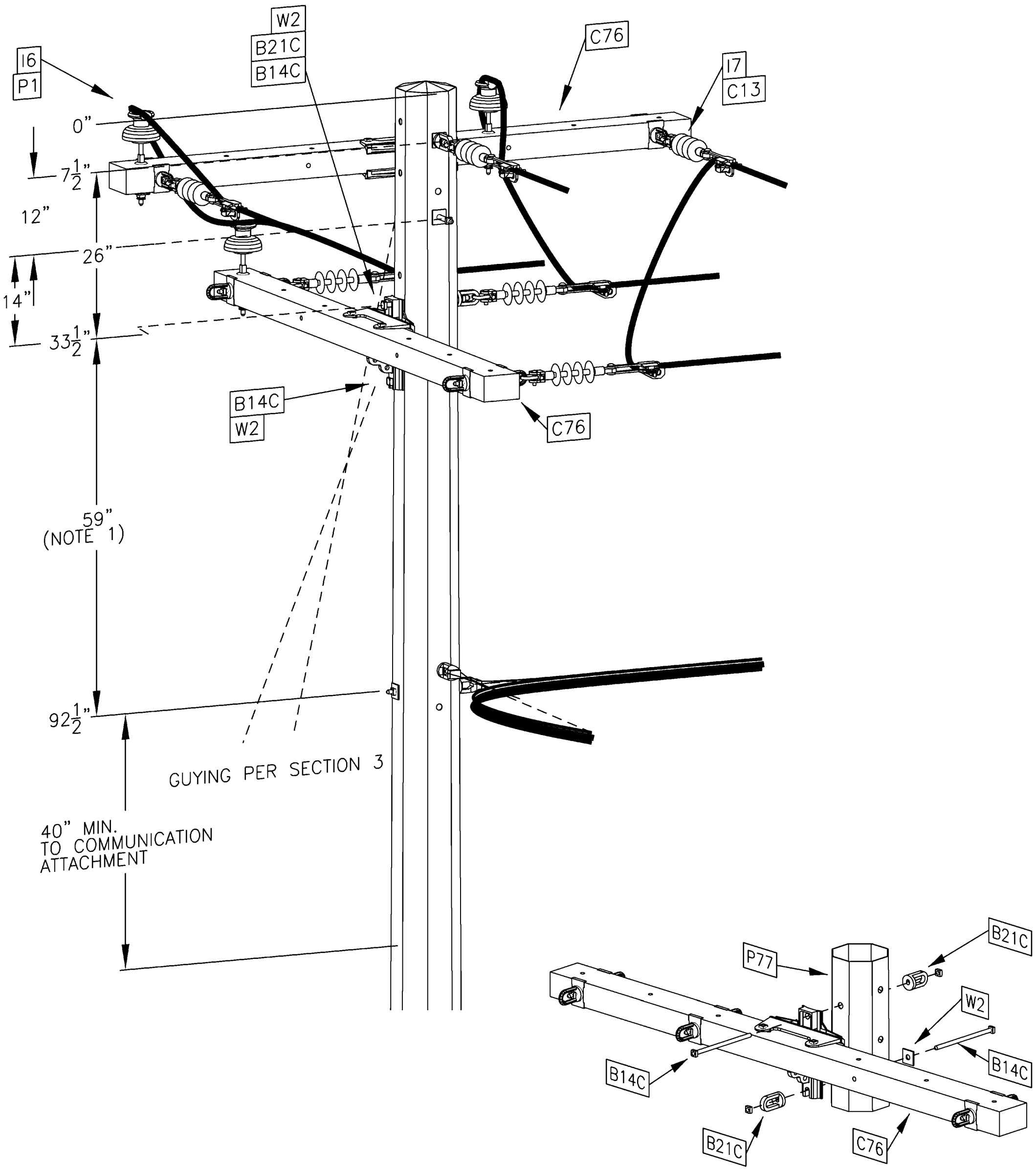
SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
92.5	45 JT-111"	185	--	--
92.5	45 JT-111"	--	185	--
97.5	45 JT-111"	--	--	180
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
103.5	45 JT-111"	255	--	--
108.5	45 JT-111"	--	185	--
108.5	45 JT-111"	--	--	175
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta circuit construction, omit the center phase.

1Φ (DELTA) AND 3Φ FIBERGLASS DEADEND CROSSARM POLE TOP – 0-15 kV ANGLES 61˚ - 90˚ AND DEADENDS			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER: 9-416	ISSUE: 7/16

MU = @9-416AF	0-15KV 3Φ - Bare	MU = @9-416AFCL	0-15KV 3Φ - Covered
MU = @9-416BF	0-15KV 1Φ - Bare	MU = @9-416BFCL	0-15KV 1Φ - Covered



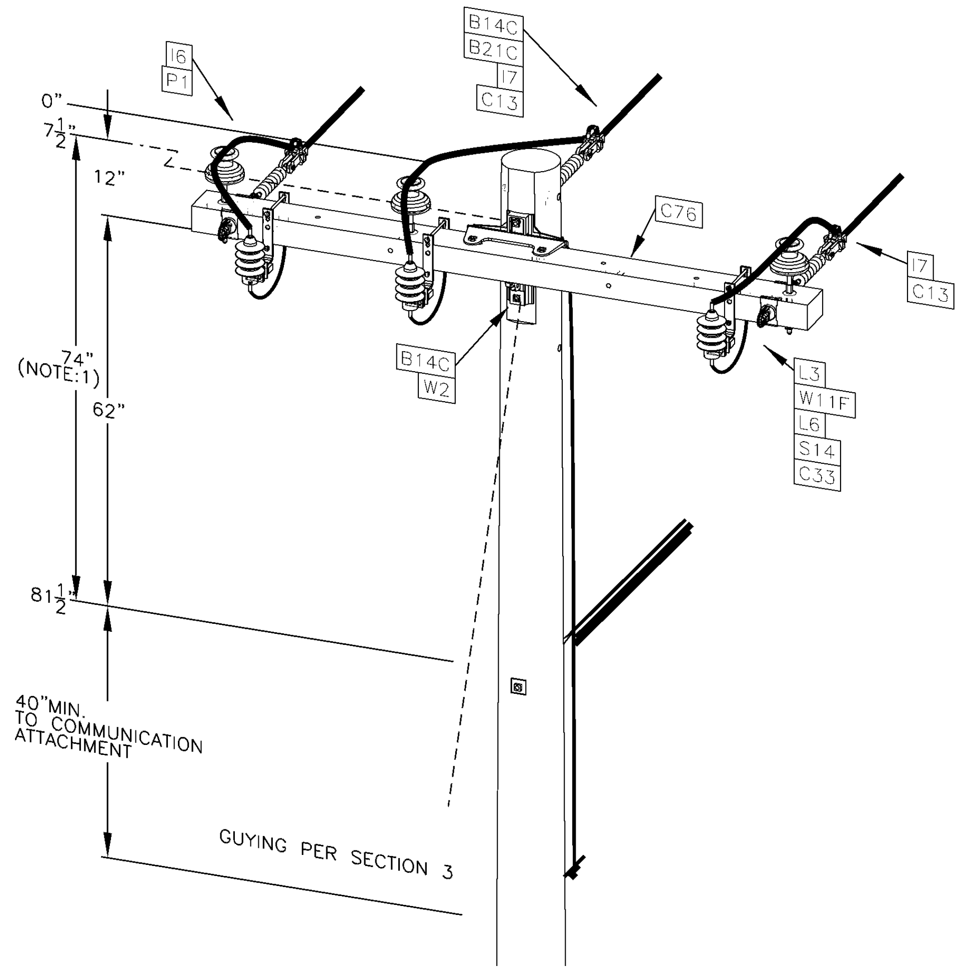
Supersedes 7/20 Issue – Corrected drawing title.

NOTES:

1. This clearance can be reduced to a minimum of 56" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. Detachable steel pole steps maybe left installed while maintaining an 8 foot minimum from ground level.
3. If grounding is necessary, install down ground & molding with appropriate grounding kit (Std Item S34) which includes nylon clips and self tapping screws. Place clips approximately 12"-18" apart.
4. Install 12.5M maximum guy wire. If 25M is required, install 2 separate 12.5M guys. The first guy in each direction can be placed on the crossarm bracket (see 9-417F for a side view of the fiberglass crossarm with a guy wire installed).
5. For single phase delta circuit construction, omit the center phase.

MU = @9-417A	0-15KV 3Φ - Bare	MU = @9-417ACL	0-15KV 3Φ - Covered
MU = @9-417B	0-15KV 1Φ - Bare	MU = @9-417BCL	0-15KV 1Φ - Covered

Supersedes 7/20 Issue – Corrected drawing title and page number.



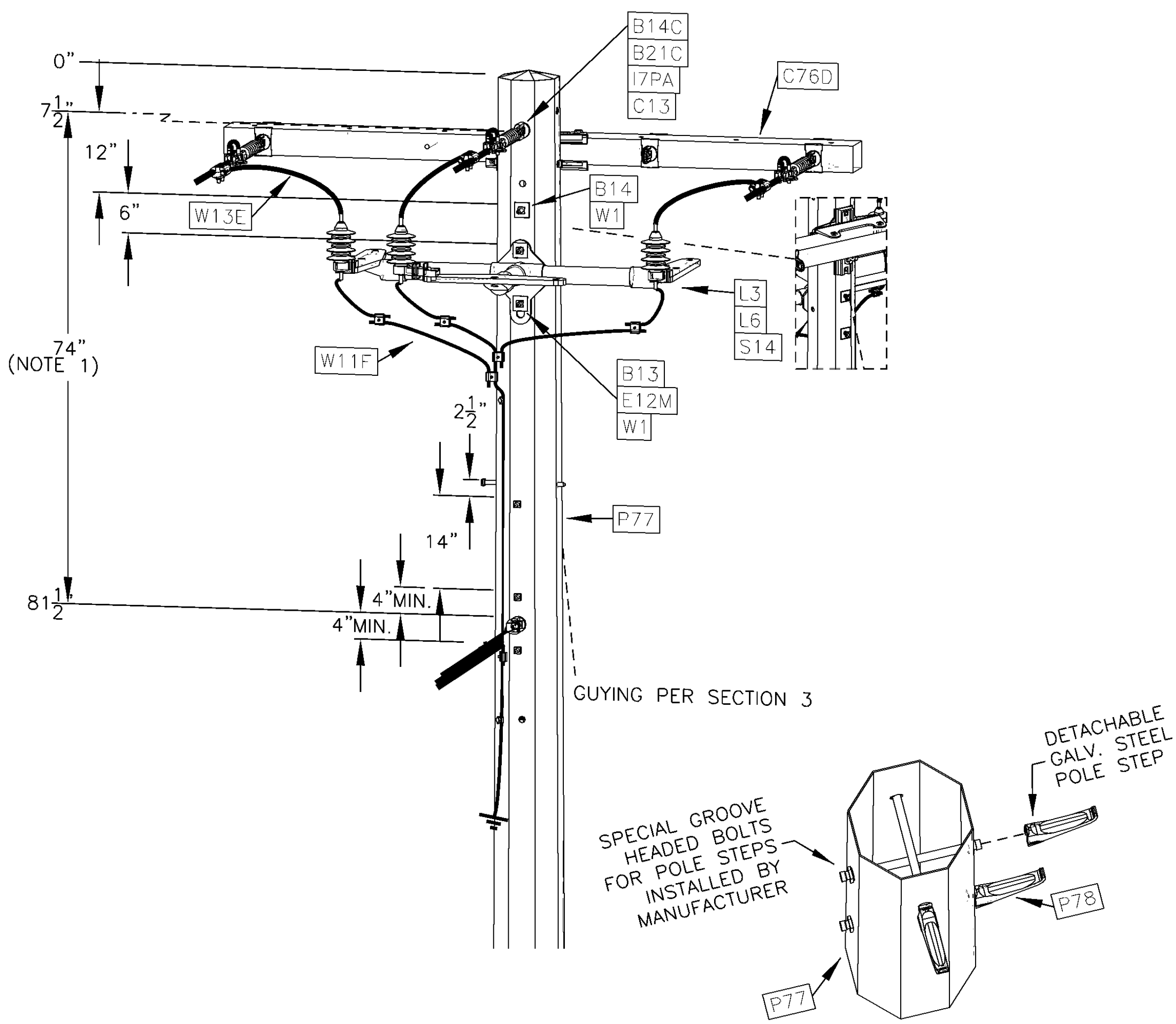
SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	185	175
86	45 JT-111"	300	--	--
106	45 JT-111"	--	240	--
107	45 JT-111"	--	--	225
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta circuit construction, omit the center phase.

1Φ (DELTA) AND 3Φ FIBERGLASS DEADEND CROSSARM POLE TOP – 0-15 kV DEADENDS			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		9-417	7/21

MU = @9-417AF	0-15KV 3Φ - Bare	MU = @9-417AFCL	0-15KV 3Φ - Covered
MU = @9-417BF	0-15KV 1Φ - Bare	MU = @9-417BFCL	0-15KV 1Φ - Covered

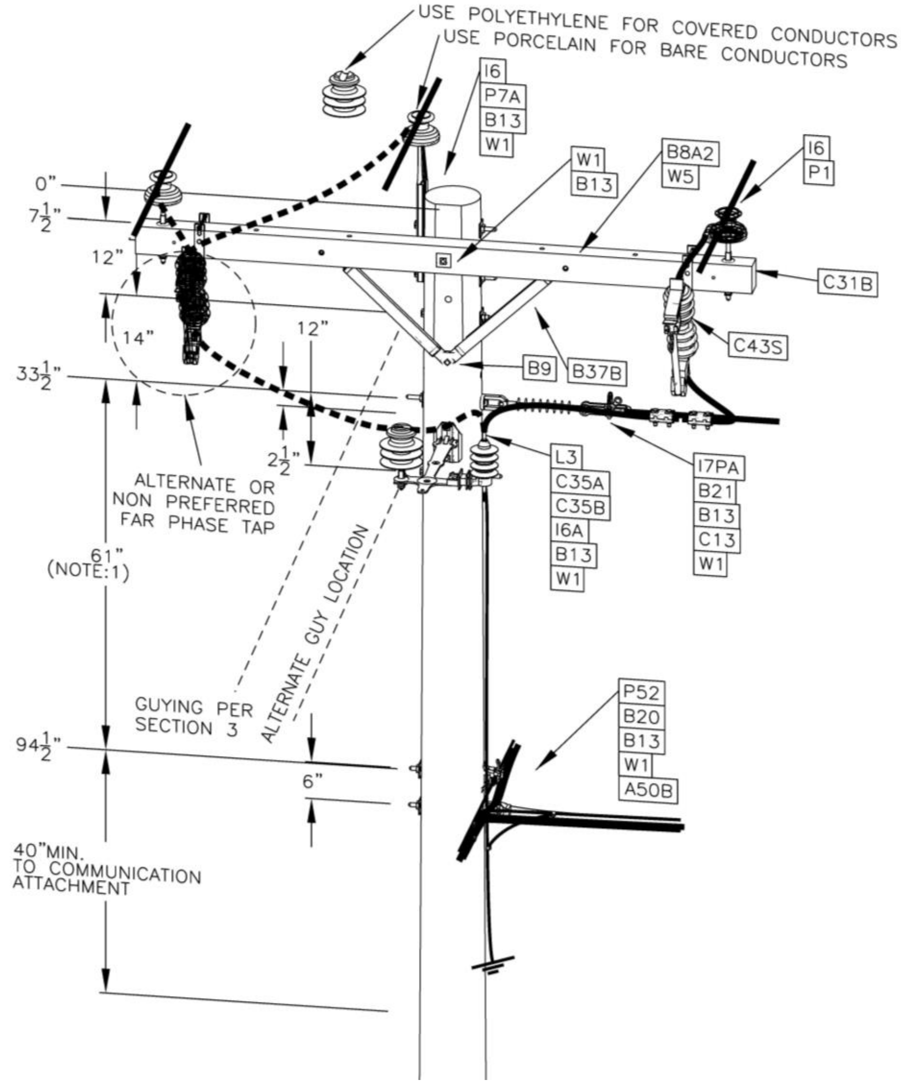


Supersedes 7/20 Issue – Corrected drawing title, page number and formatting.

NOTES:

1. This clearance can be reduced to a minimum of 54” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. Detachable steel pole steps maybe left installed while maintaining an 8 foot minimum from ground level.
3. If grounding is necessary, install down ground & molding with appropriate grounding kit (Std Item S34) which includes nylon clips and self tapping screws. Place clips approximately 12”-18” apart.
4. Install 12.5M maximum guy wire. If 25M is required, install 2 separate 12.5M guys.
5. For single phase delta circuit construction, omit the center phase.

MU = @9-419F1A	0-15KV 3Φ - Bare	MU = @9-419F1ACL	0-15KV 3Φ - Covered
MU = @9-419F1B	0-15KV 1Φ - Bare	MU = @9-419F1BCL	0-15KV 1Φ - Covered



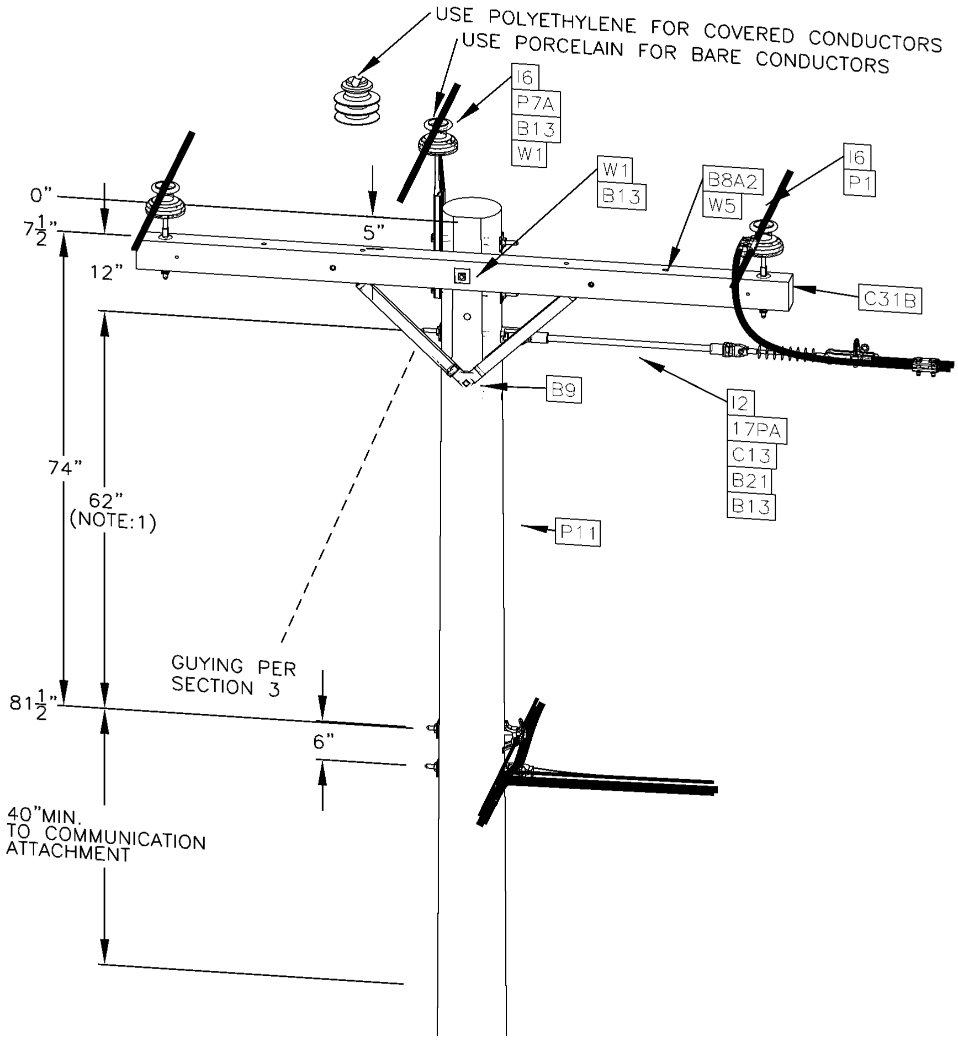
SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
94.5	45 JT-111"	180	180	180	180
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
94.5	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
109	45 JT-111"	--	--	240	--
94.5	45 JT-111"	--	--	--	207
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

NOTES:

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

Supersedes 7/20 Issue – Corrected page number and formatting.

1Φ AND 3Φ CROSSARM POLE TOP – 0-15 kV – (PREFERRED)
0˚ - 10˚ – TAP TO 1Φ ARMLESS



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	135	135	135	135
81.5	45 JT-111"	220	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	225	195	186	210
81.5	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
109	45 JT-111"	--	--	240	--
81.5	45 JT-111"	--	--	--	210
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

Supersedes 7/20 Issue – Corrected page number and formatting.

NOTES:

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. If this configuration is needed, the fused cutout and arrester for the tap **must** be placed on the next pole down the tap. Otherwise, Drawing 9-419 FIG1 shall be used.

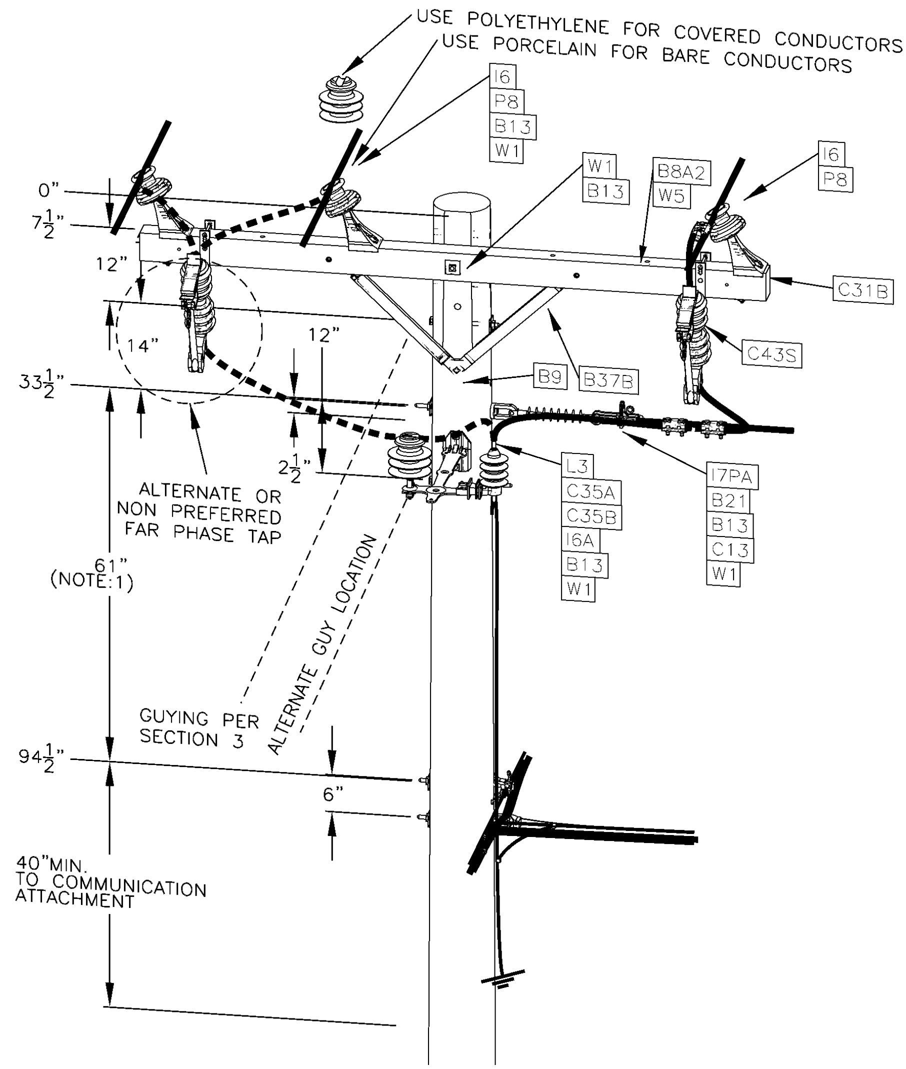
MU = @9-420A	0-5KV 3Φ - Bare	MU = @9-420ACL	0-5KV 3Φ - Covered
MU = @9-420B	0-5KV 1Φ - Bare	MU = @9-420BCL	0-5KV 1Φ - Covered

Supersedes 7/20 Issue – Corrected page formatting.

Drawing 9-420 has been removed.

Refer to Drawing 9-435.

MU = @9-421F1A	0-15KV 3Φ - Bare	MU = @9-421F1ACL	0-15KV 3Φ - Covered
MU = @9-421F1B	0-15KV 1Φ - Bare	MU = @9-421F1BCL	0-15KV 1Φ - Covered



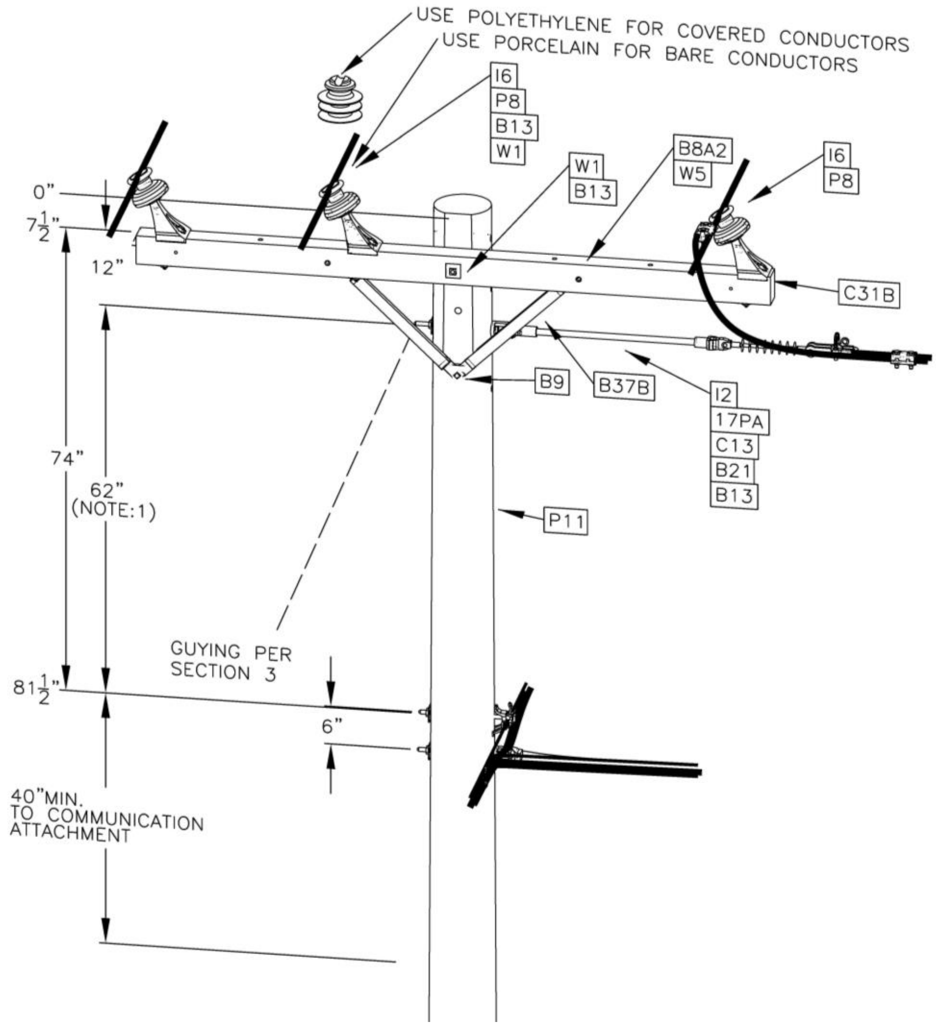
SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
94.5	45 JT-111"	180	180	180	180
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
94.5	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
109	45 JT-111"	--	--	240	--
94.5	45 JT-111"	--	--	--	207
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

NOTES:

1. This clearance can be reduced to a minimum of 56" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

Supersedes 7/20 Issue – Corrected page formatting.

MU = @9-421F2A	0-15KV 3Φ - Bare	MU = @9-421F2ACL	0-15KV 3Φ - Covered
MU = @9-421F2B	0-15KV 1Φ - Bare	MU = @9-421F2BCL	0-15KV 1Φ - Covered



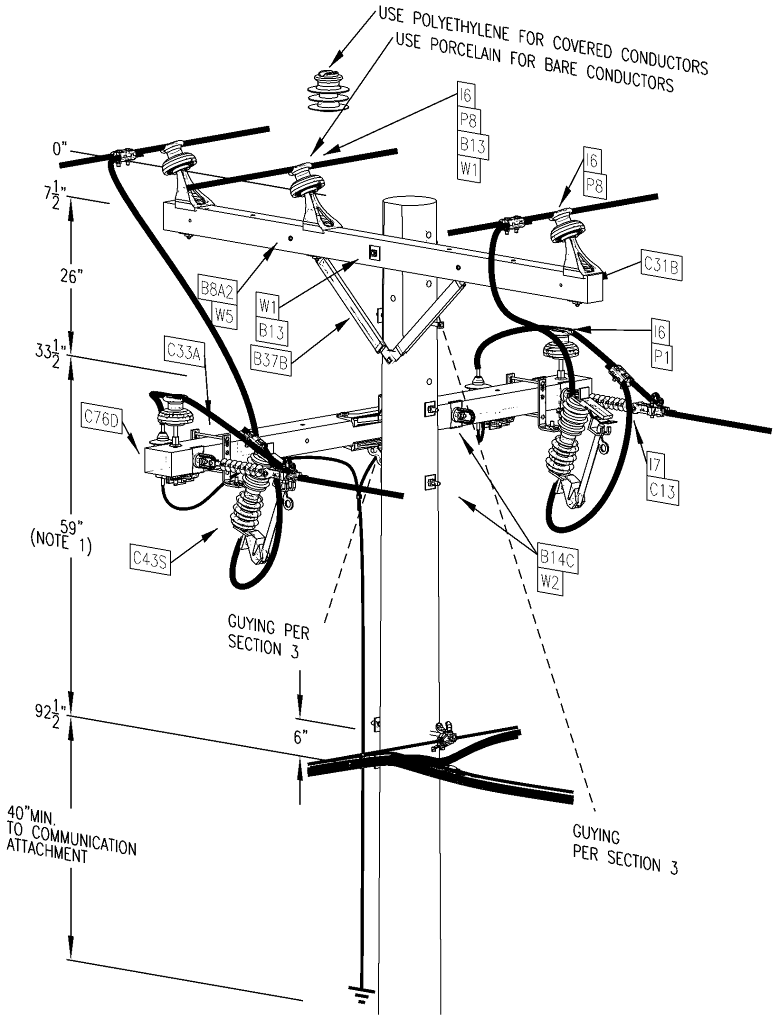
SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	135	135	135	135
81.5	45 JT-111"	220	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	225	195	186	210
81.5	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
109	45 JT-111"	--	--	240	--
81.5	45 JT-111"	--	--	--	210
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

NOTES: This clearance can be reduced to a minimum of 56" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

1. If this configuration is needed, the fused cutout and arrester for the tap **must** be placed on the next pole down the tap. Otherwise, Drawing 9-421 FIG1 shall be used.

Supersedes 7/20 Issue – Corrected page formatting.

MU = @9-422A	0-5KV 3Φ - Bare	MU = @9-422ACL	0-5KV 3Φ - Covered
MU = @9-422B	0-5KV 1Φ - Bare	MU = @9-422BCL	0-5KV 1Φ - Covered



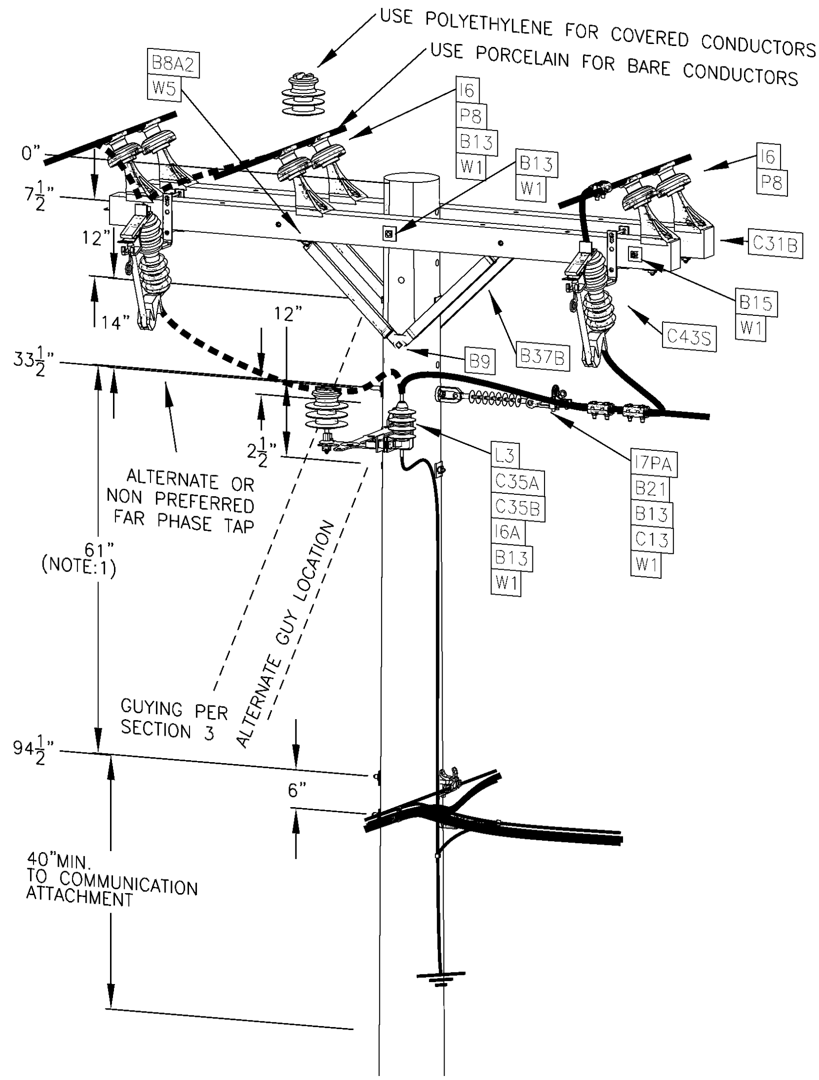
SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	135	135	135	100
81.5	45 JT-111"	220	220	220	100
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	225	195	186	80
81.5	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
109	45 JT-111"	--	--	240	--
81.5	45 JT-111"	--	--	--	85
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

NOTES:

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta main line, omit center phase on top crossarm.

Supersedes 7/20 Issue – Corrected page formatting.

MU = @9-423F1A	0-15KV 3Φ - Bare	MU = @9-423F1ACL	0-15KV 3Φ - Covered
MU = @9-423F1B	0-15KV 1Φ - Bare	MU = @9-423F1BCL	0-15KV 1Φ - Covered



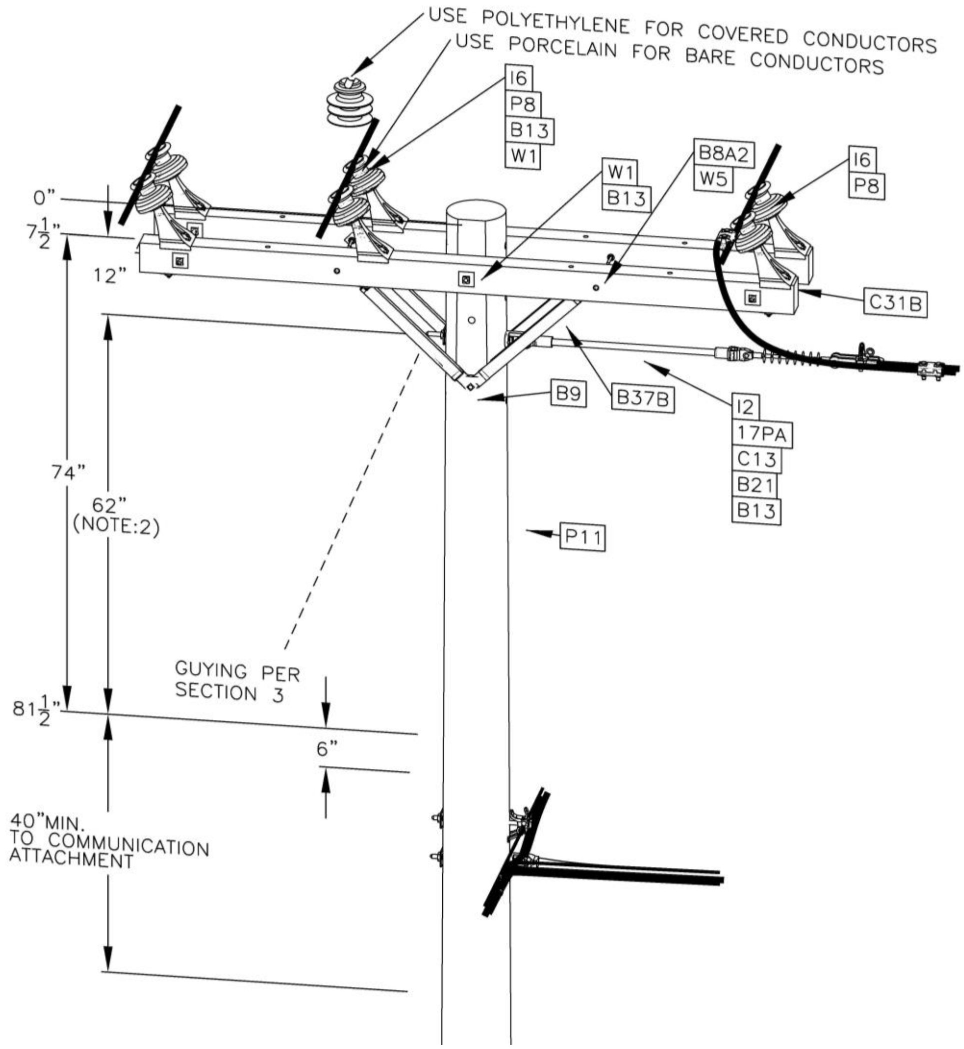
Supersedes 7/20 Issue – Corrected page formatting.

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
94.5	45 JT-111"	180	180	180	180
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
94.5	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
109	45 JT-111"	--	--	240	--
94.5	45 JT-111"	--	--	--	207
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

NOTES:

1. This clearance can be reduced to a minimum of 56" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

MU = @9-423F2A	0-15KV 3Φ - BARE	MU = @9-423F2ACL	0-15KV 3Φ - Covered
MU = @9-423F2B	0-15KV 1Φ - BARE	MU = @9-423F2BCL	0-15KV 1Φ - Covered



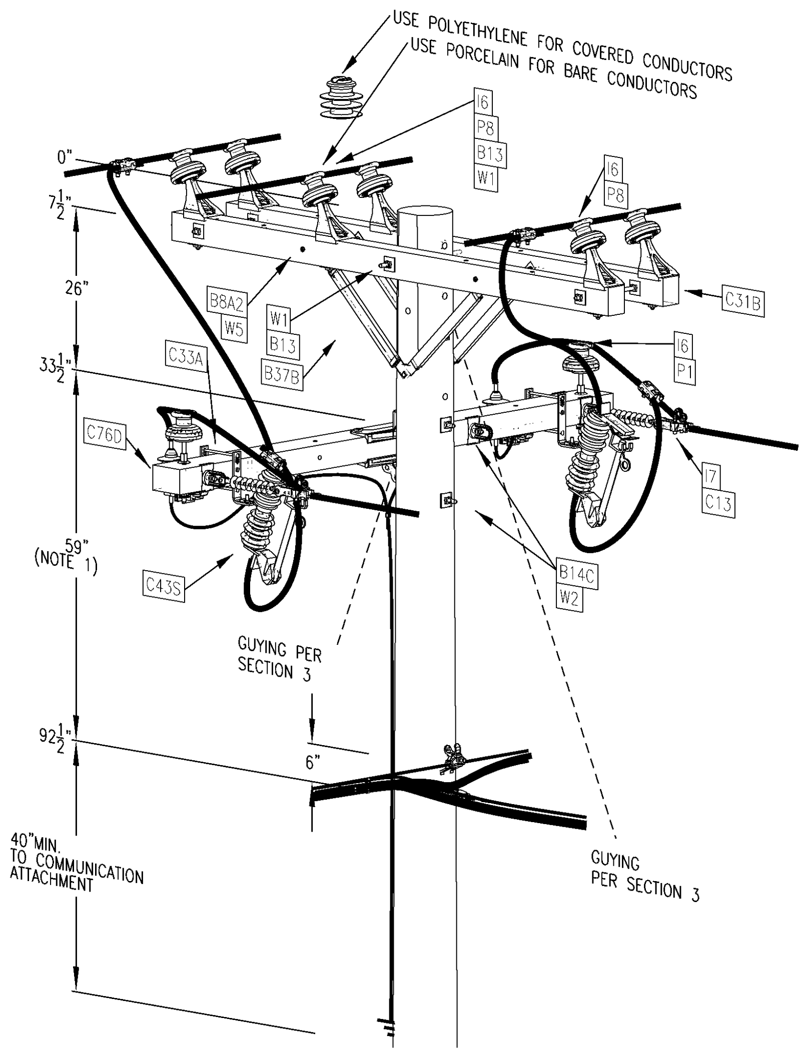
Supersedes 7/20 Issue – Corrected page formatting.

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	135	135	135	135
81.5	45 JT-111"	220	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	225	195	186	210
81.5	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
109	45 JT-111"	--	--	240	--
81.5	45 JT-111"	--	--	--	210
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

NOTES:

1. If this configuration is needed, the fused cutout and arrester for the tap **must** be placed on the next pole down the tap. Otherwise, Drawing 9-423 FIG1 shall be used.
2. This clearance can be reduced to a minimum of 56" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

MU = @9-424A	0-5KV 3Φ - Bare	MU = @9-424ACL	0-5KV 3Φ - Covered
MU = @9-424B	0-5KV 1Φ - Bare	MU = @9-424BCL	0-5KV 1Φ - Covered



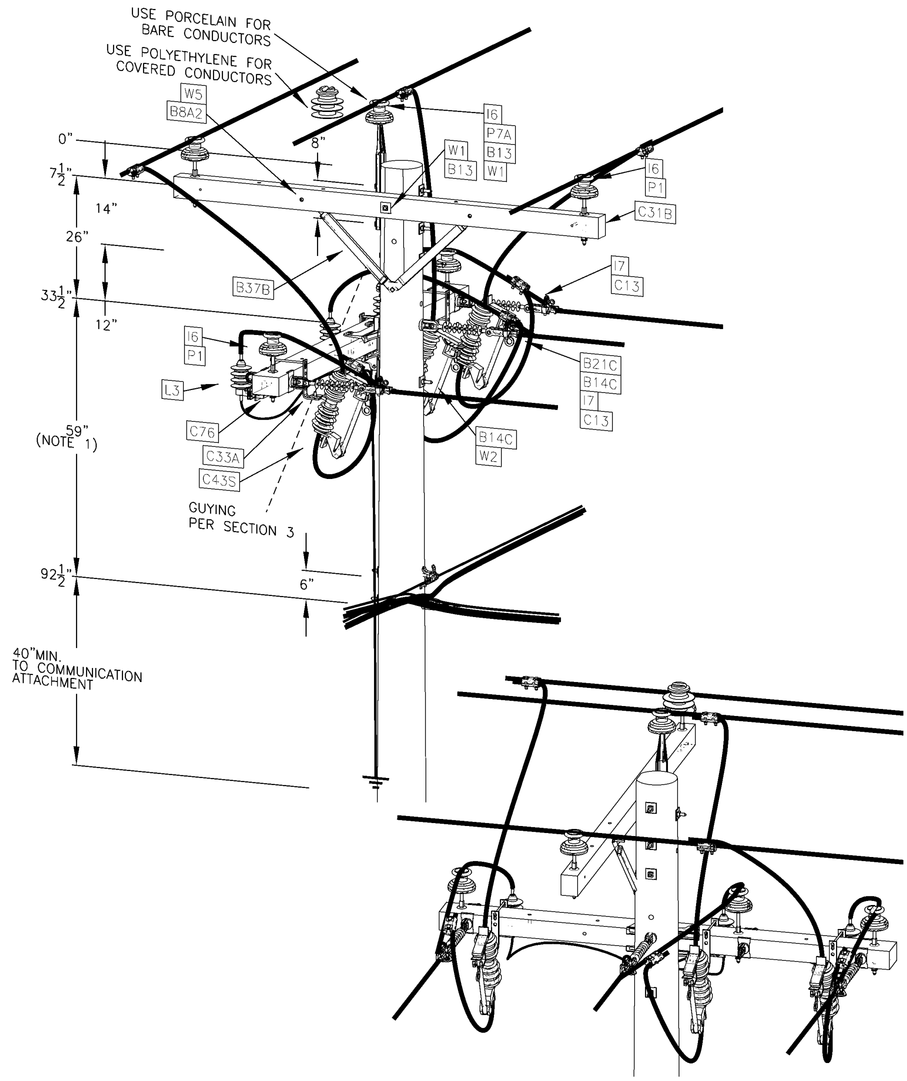
Supersedes 7/20 Issue – Corrected page formatting.

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	135	135	135	100
81.5	45 JT-111"	220	220	220	100
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
81.5	40 JT-84"	225	195	186	80
81.5	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
109	45 JT-111"	--	--	240	--
81.5	45 JT-111"	--	--	--	85
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

NOTES:

1. This clearance can be reduced to a minimum of 56" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta main line, omit center phase on top crossarm.

MU = @9-435A	0-15KV 3Φ - Bare	MU = @9-435ACL	0-15KV 3Φ - Covered
MU = @9-435B	0-15KV 1Φ - Bare	MU = @9-435BCL	0-15KV 1Φ - Covered



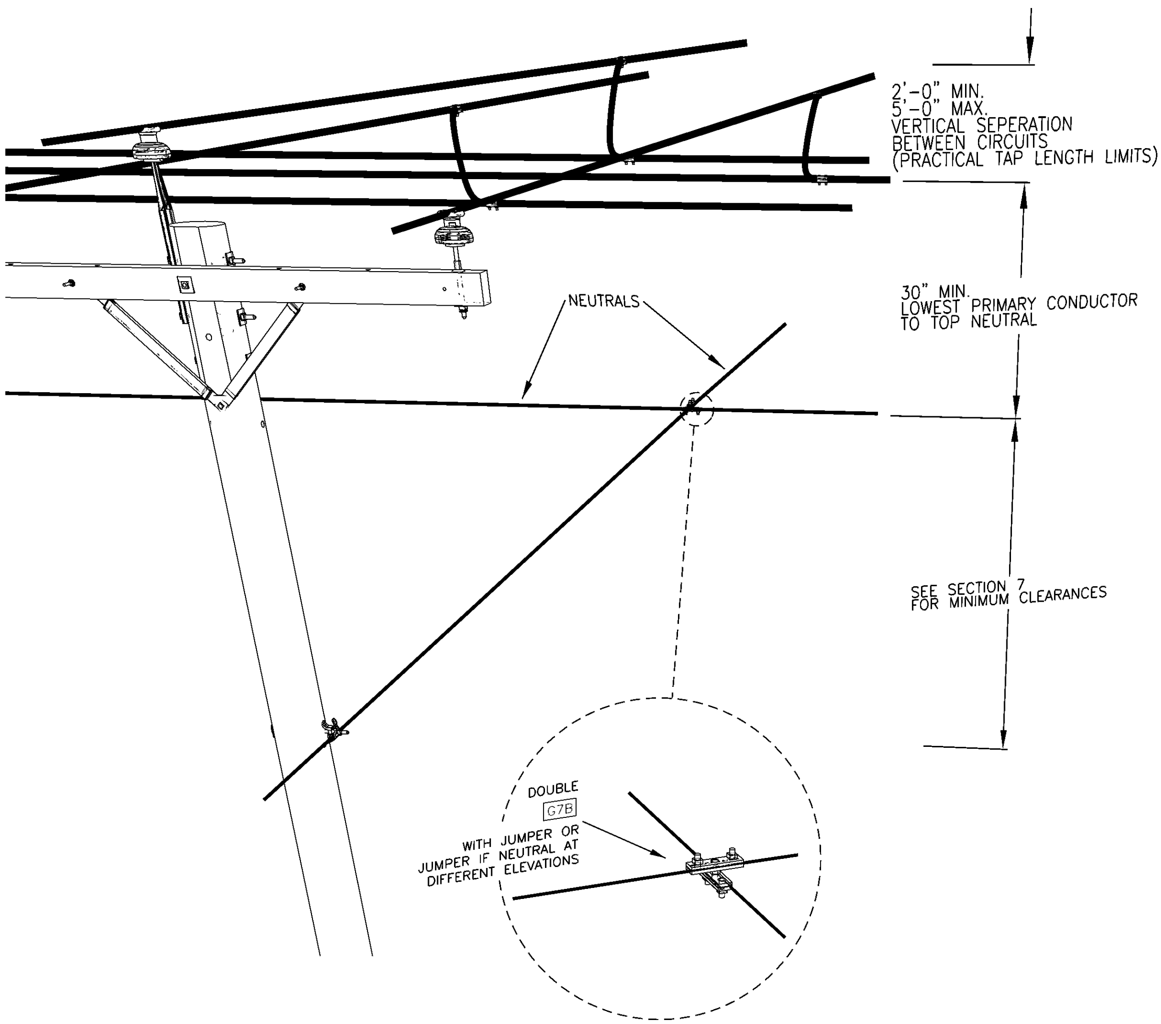
Supersedes 7/20 Issue – Corrected page formatting.

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
92.5	45 JT-111"	185	--	--
92.5	45 JT-111"	--	185	--
97.5	45 JT-111"	--	--	180
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
103.5	45 JT-111"	255	--	--
108.5	45 JT-111"	--	185	--
108.5	45 JT-111"	--	--	175
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. For single phase delta circuit construction, omit the center phases.

1Φ AND 3Φ CROSSARM POLE TOP – 0-15 kV
0˚ - 10˚ – TAP TO 1Φ OR 3Φ CROSSARM



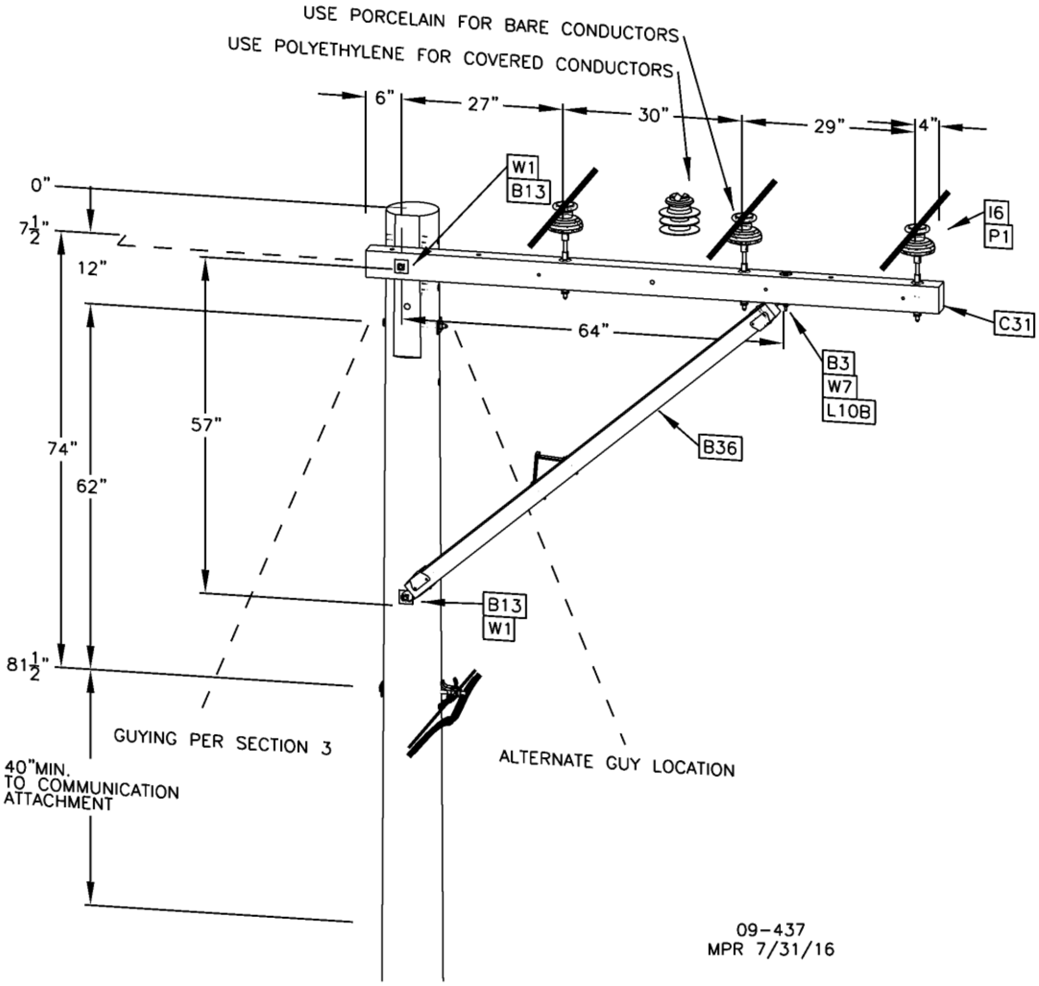
Supersedes 7/20 Issue – Corrected page formatting.

NOTES:
1. Midspan taps may be required where poles are set back at heavy intersections.
2. See Drawing 9-435 for standard 3-phase taps at the pole.
3. Refer to Page 9-105 for information on relative phase positioning.
4. Always wire brush the surface of conductors immediately before installing any type of connector.
5. See Section 5 for more details on connectors available.

PRIMARY MIDSPAN TAP

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	9-436	7/21

MU = @9-437A	0-15KV 3Φ - Bare	MU = @9-437ACL	0-15KV 3Φ - Covered
MU = @9-437B	0-15KV 1Φ - Bare	MU = @9-437BCL	0-15KV 1Φ - Covered



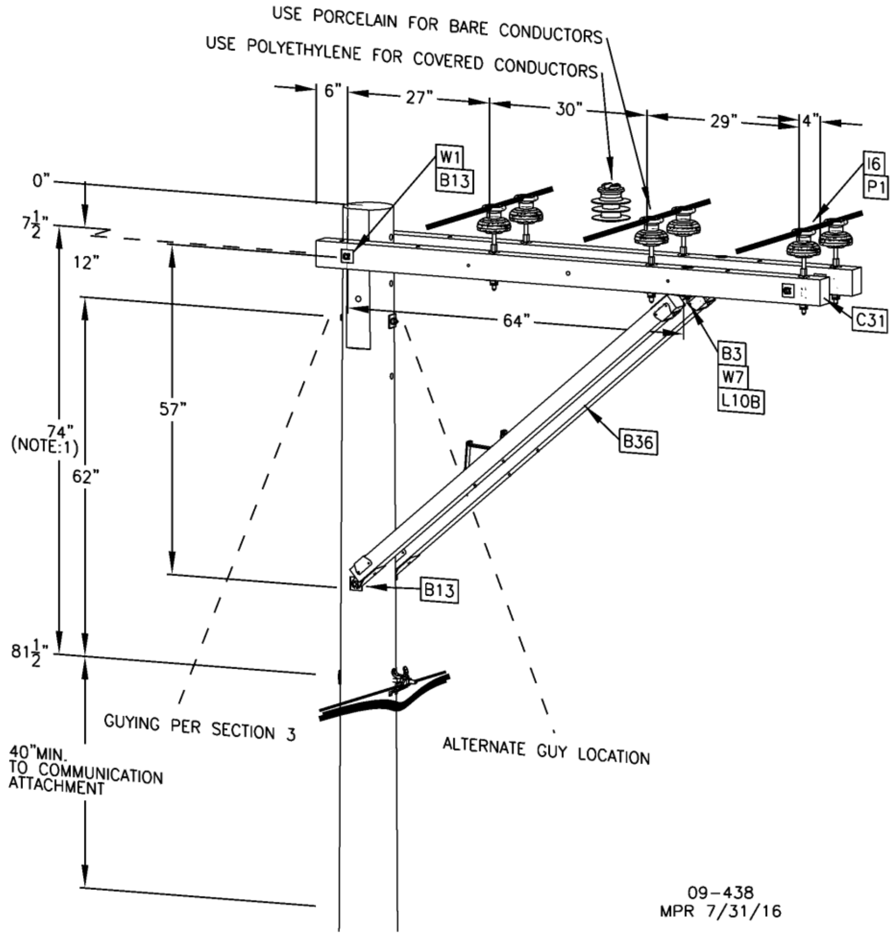
SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES:

1. Alley arm construction shall be used only as required for lateral clearance to avoid restricted tree trimming or to eliminate some offset line conditions.
2. For single phase delta, omit the center conductor.
3. Guying is not always necessary for in-line poles with offset arms unless calculated forces are exceeding pole strength (refer to Section 3 for guying information).
4. Two or more adjacent poles with extension arms shall be used to reduce the excessive lateral stress.

Supersedes 7/20 Issue – Corrected page formatting.

MU = @9-438A	0-15KV 3Φ - Bare	MU = @9-438ACL	0-15KV 3Φ - Covered
MU = @9-438B	0-15KV 1Φ - Bare	MU = @9-438BCL	0-15KV 1Φ - Covered

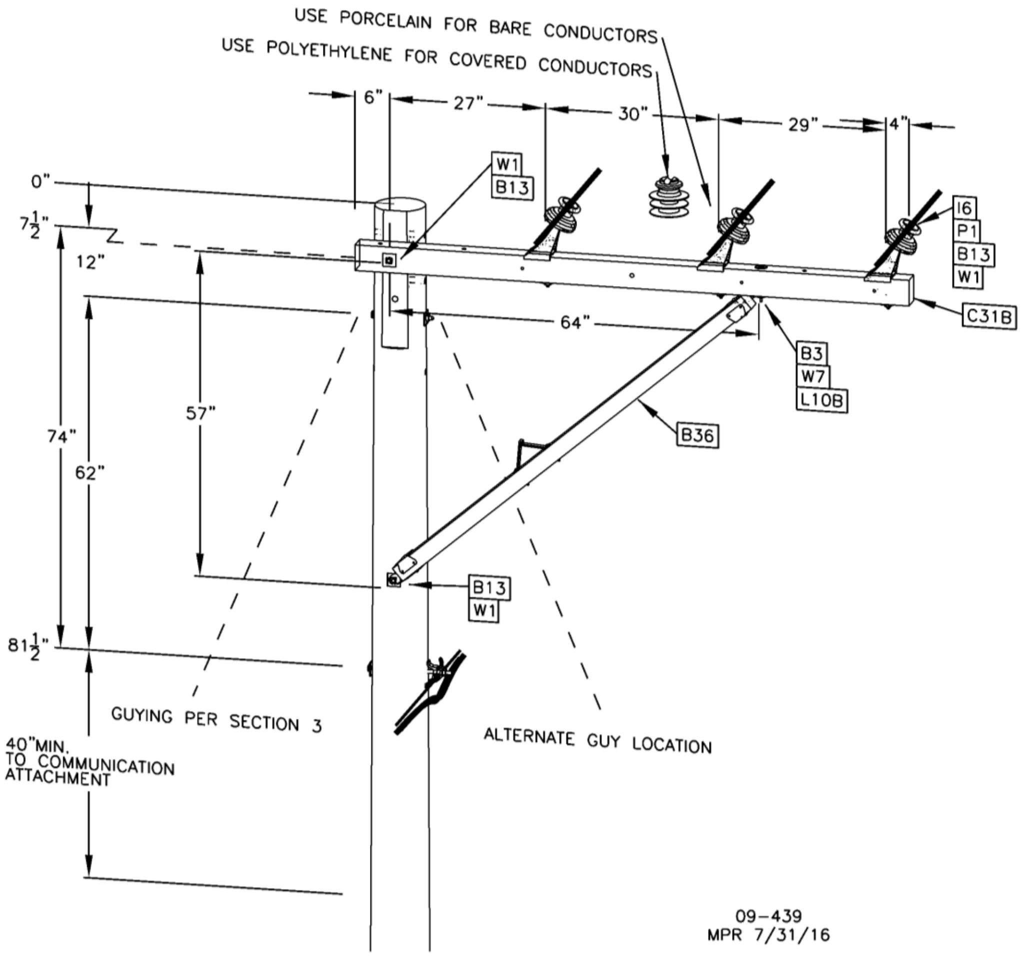


SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES:
1. Alley arm construction shall be used only as required for lateral clearance to avoid restricted tree trimming or to eliminate some offset line conditions.
2. For single phase delta, omit the center conductor.
3. Guying is not always necessary for in-line poles with offset arms unless calculated forces are exceeding pole strength (refer to Section 3 for guying information).
4. Two or more adjacent poles with extension arms shall be used to reduce the excessive lateral stress.

Supersedes 7/20 Issue – Corrected page formatting.

MU = @9-439A	0-15KV 3Φ - Bare	MU = @9-439ACL	0-15KV 3Φ - Covered
MU = @9-439B	0-15KV 1Φ - Bare	MU = @9-439BCL	0-15KV 1Φ - Covered



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

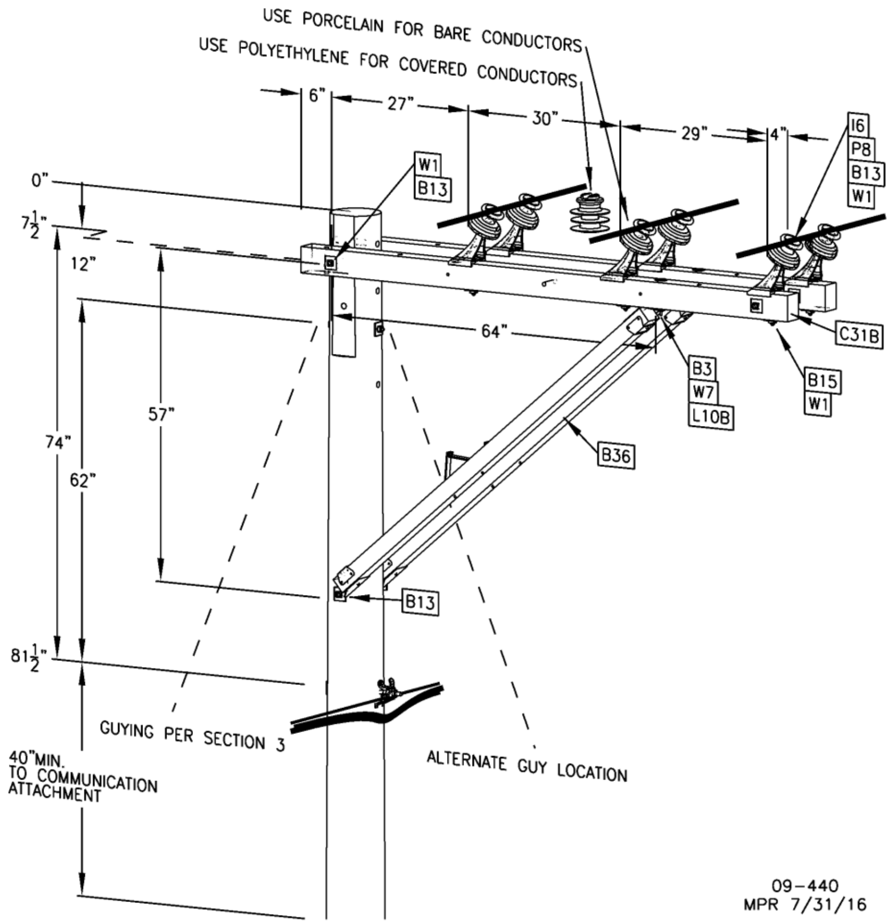
Supersedes 7/20 Issue – Corrected page formatting.

NOTES:

1. Alley arm construction shall be used only as required for lateral clearance to avoid restricted tree trimming or to eliminate some offset line conditions.
2. For single phase delta, omit the center conductor.
3. Guying is not always necessary for in-line poles with offset arms unless calculated forces are exceeding pole strength (refer to Section 3 for guying information).
4. Two or more adjacent poles with extension arms shall be used to reduce the excessive lateral stress.

MU = @9-440A	0-15KV 3Φ - Bare	MU = @9-440ACL	0-15KV 3Φ - Covered
MU = @9-440B	0-15KV 1Φ - Bare	MU = @9-440BCL	0-15KV 1Φ - Covered

Supersedes 7/20 Issue – Corrected page formatting.

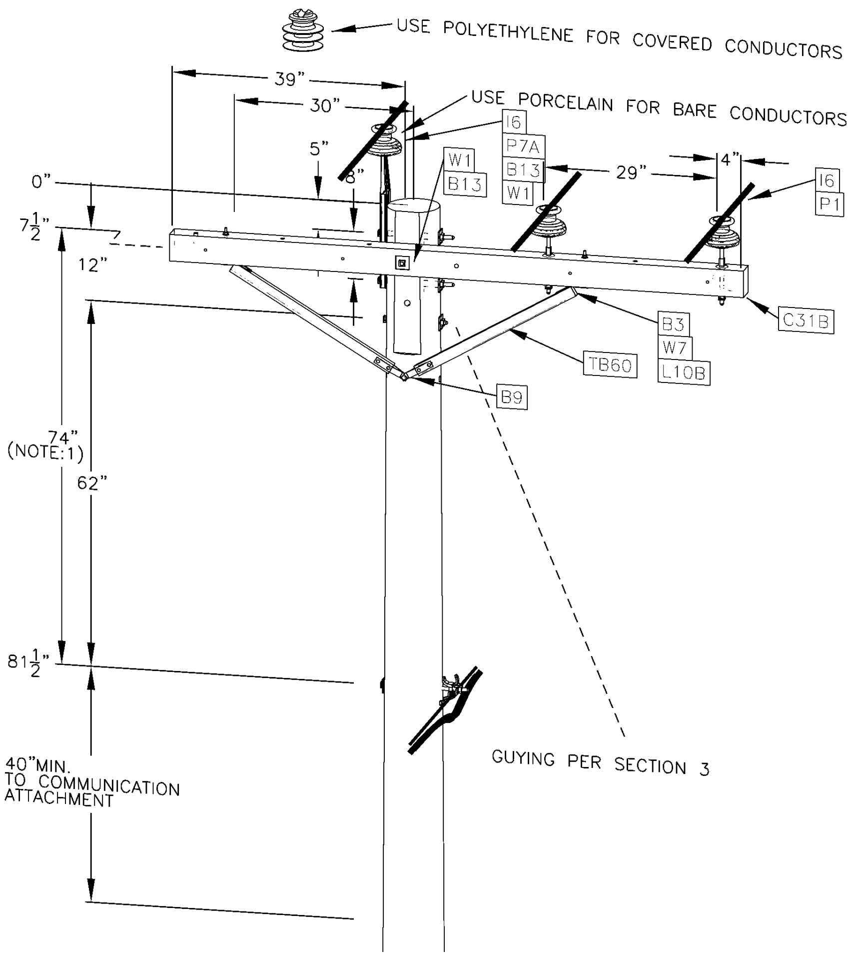


SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES:

1. Alley arm construction shall be used only as required for lateral clearance to avoid restricted tree trimming or to eliminate some offset line conditions.
2. For single phase delta, omit the center conductor.
3. Guying is not always necessary for in-line poles with offset arms unless calculated forces are exceeding pole strength (refer to Section 3 for guying information).
4. Two or more adjacent poles with extension arms shall be used to reduce the excessive lateral stress.

MU = @9-441A	0-15KV 3Φ - Bare	MU = @9-441ACL	0-15KV 3Φ - Covered
MU = @9-441B	0-15KV 1Φ - Bare	MU = @9-441BCL	0-15KV 1Φ - Covered



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

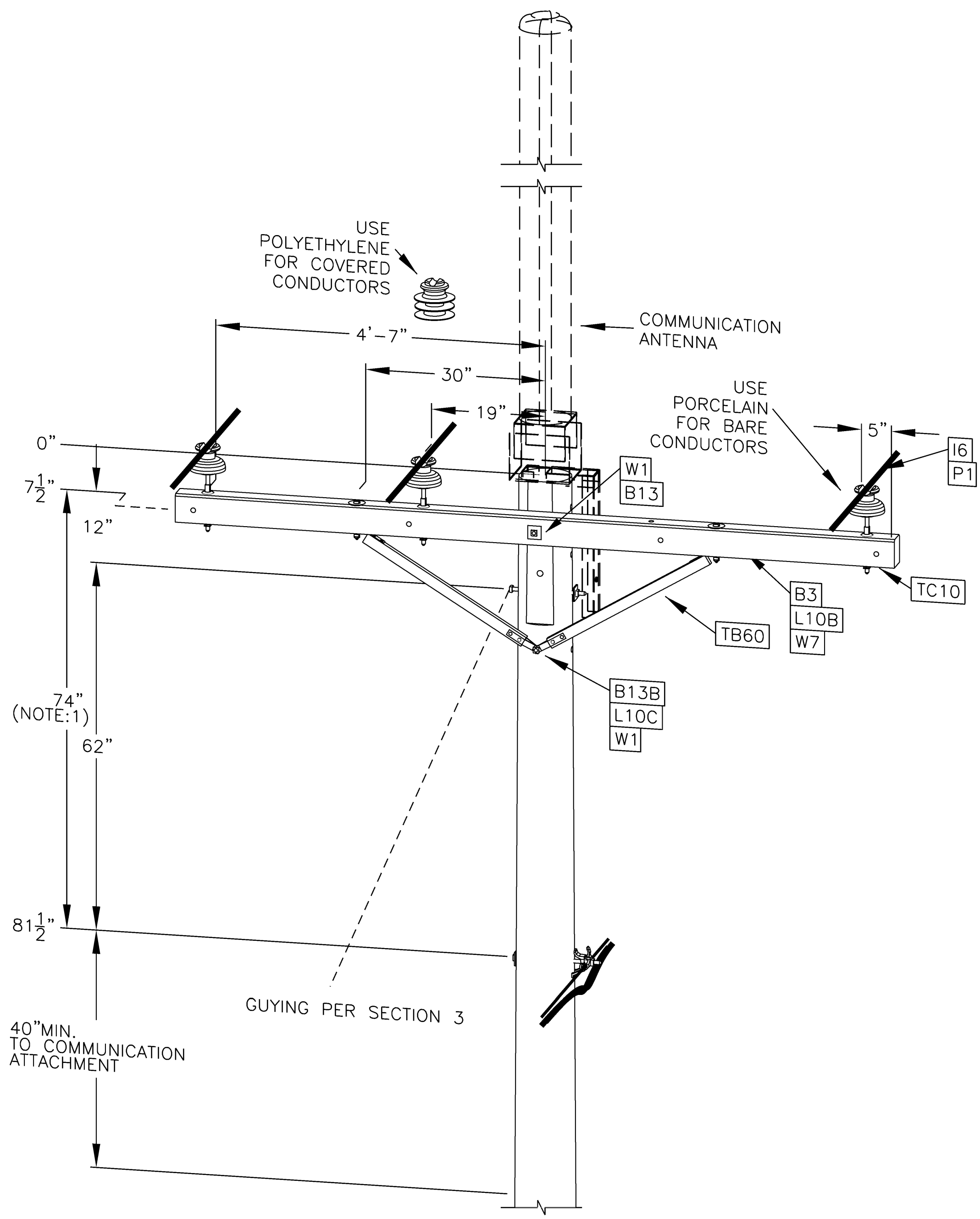
NOTES:

1. This clearance can be reduced to a minimum of 48" if needed.
2. Offset arm construction shall be used only as required for lateral clearance to avoid restricted tree trimming or to eliminate some offset line conditions.
3. For single phase delta, omit the center conductor.
4. Guying is not always necessary for in-line poles with offset arms unless calculated forces are exceeding pole strength (refer to Section 3 for guying information).

Supersedes 7/20 Issue – Corrected page formatting.

MU = @9-450A	0-15KV 3Φ - Bare	MU = @9-450ACL	0-15KV 3Φ - Covered

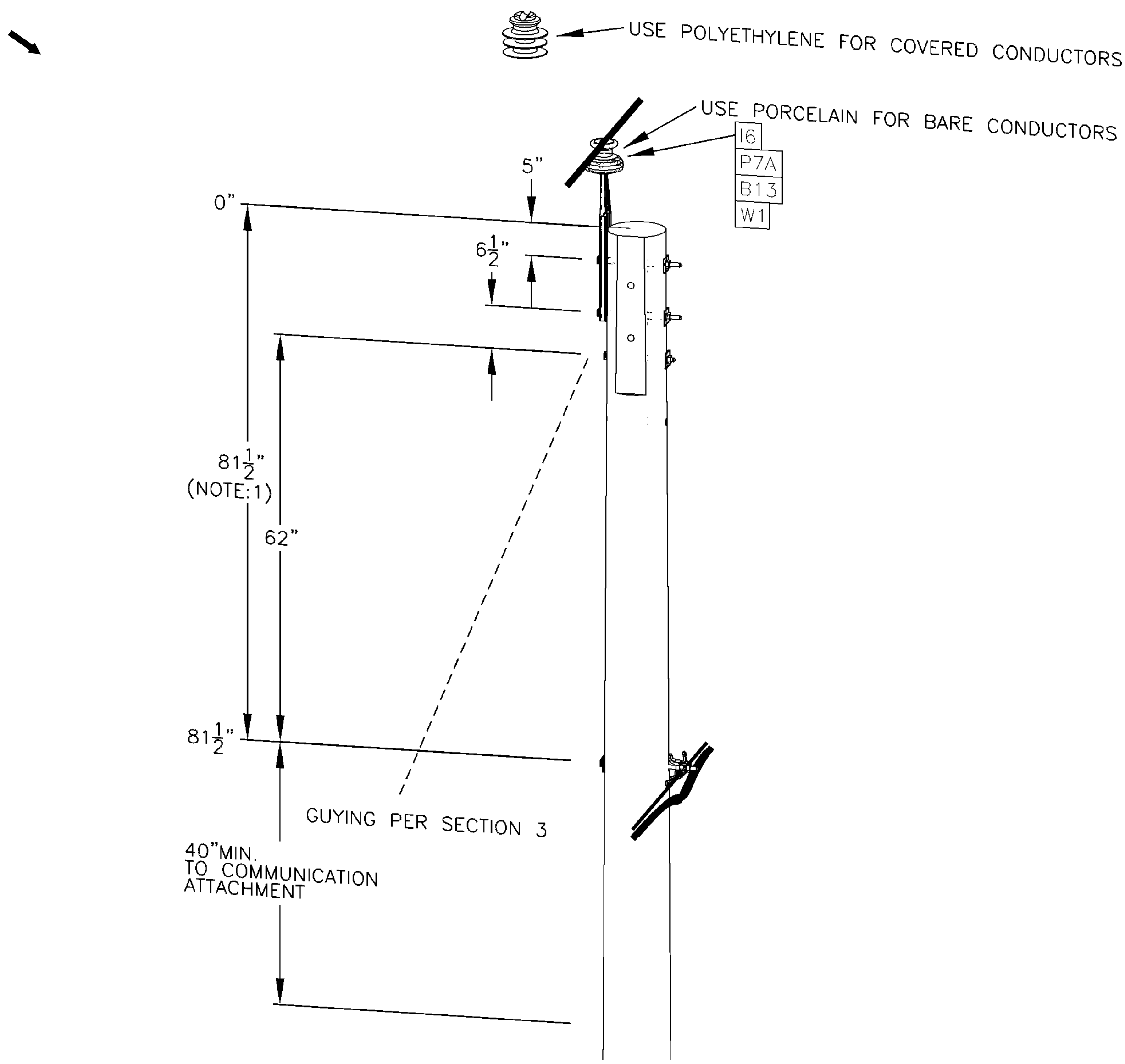
Supersedes 7/20 Issue – Corrected page formatting.



NOTES

1. This clearance can be reduced to a minimum of 48" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearance

MU = @9-711	0-15KV 1Φ - Bare	MU = @9-711CL	0-15KV 1Φ - Covered	
MU = @9-711AF	0-15KV 1Φ - Bare	MU = @9-711AFCL	0-15KV 1Φ - Covered	Fiberglass pole



Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

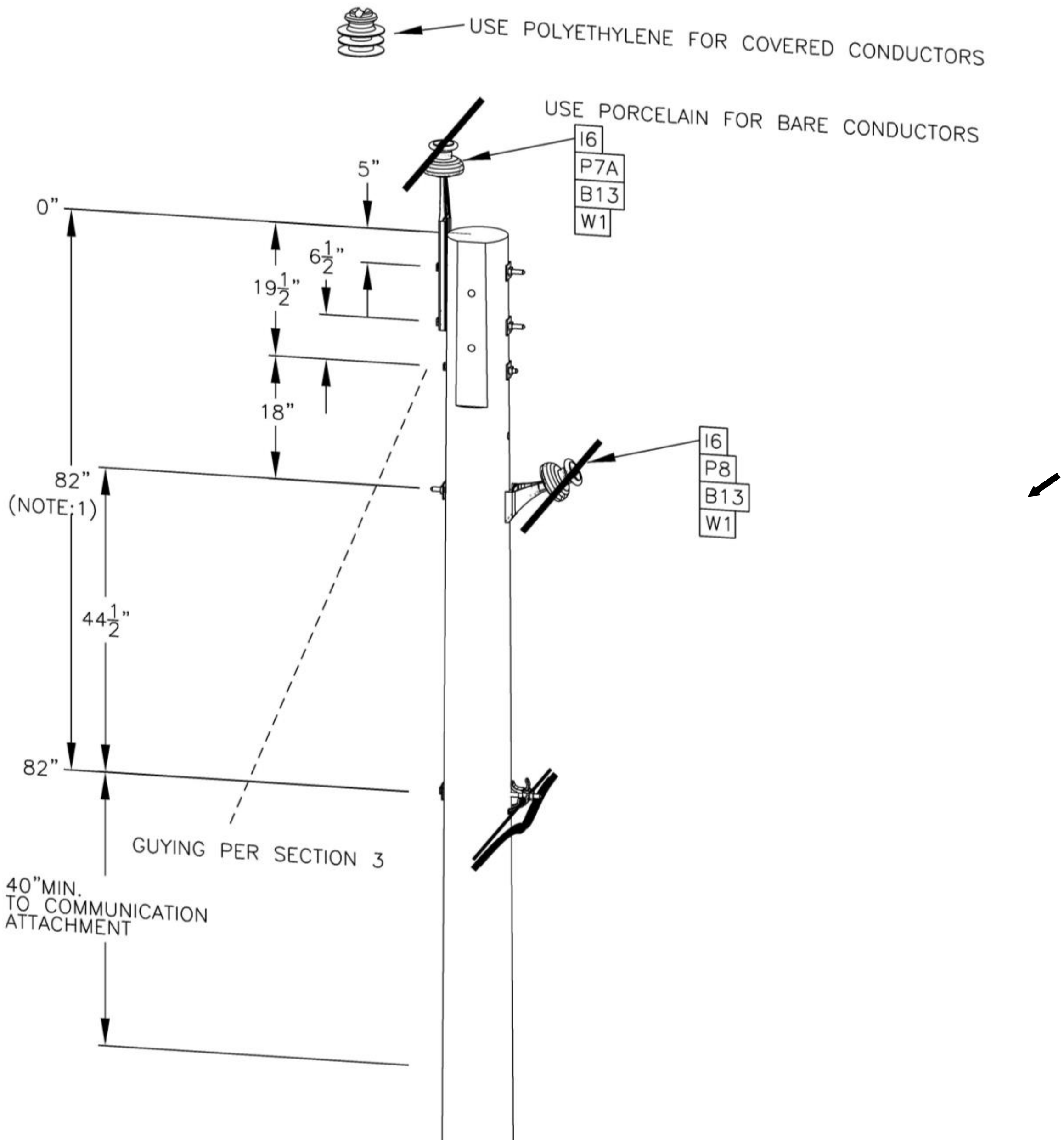
SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	195	186
81.5	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
109	45 JT-111"	--	--	240
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES:

1. This clearance can be reduced to a minimum of 48" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

MU = @9-712	0-5KV 1Φ - Bare	MU = @9-712CL	0-5KV 1Φ - Covered	
MU = @9-712F	0-5KV 1Φ - Bare	MU = @9-712FCL	0-5KV 1Φ - Covered	Fiberglass Pole

Supersedes 7/16 Issue – Corrected angle pin from P7A to P8.

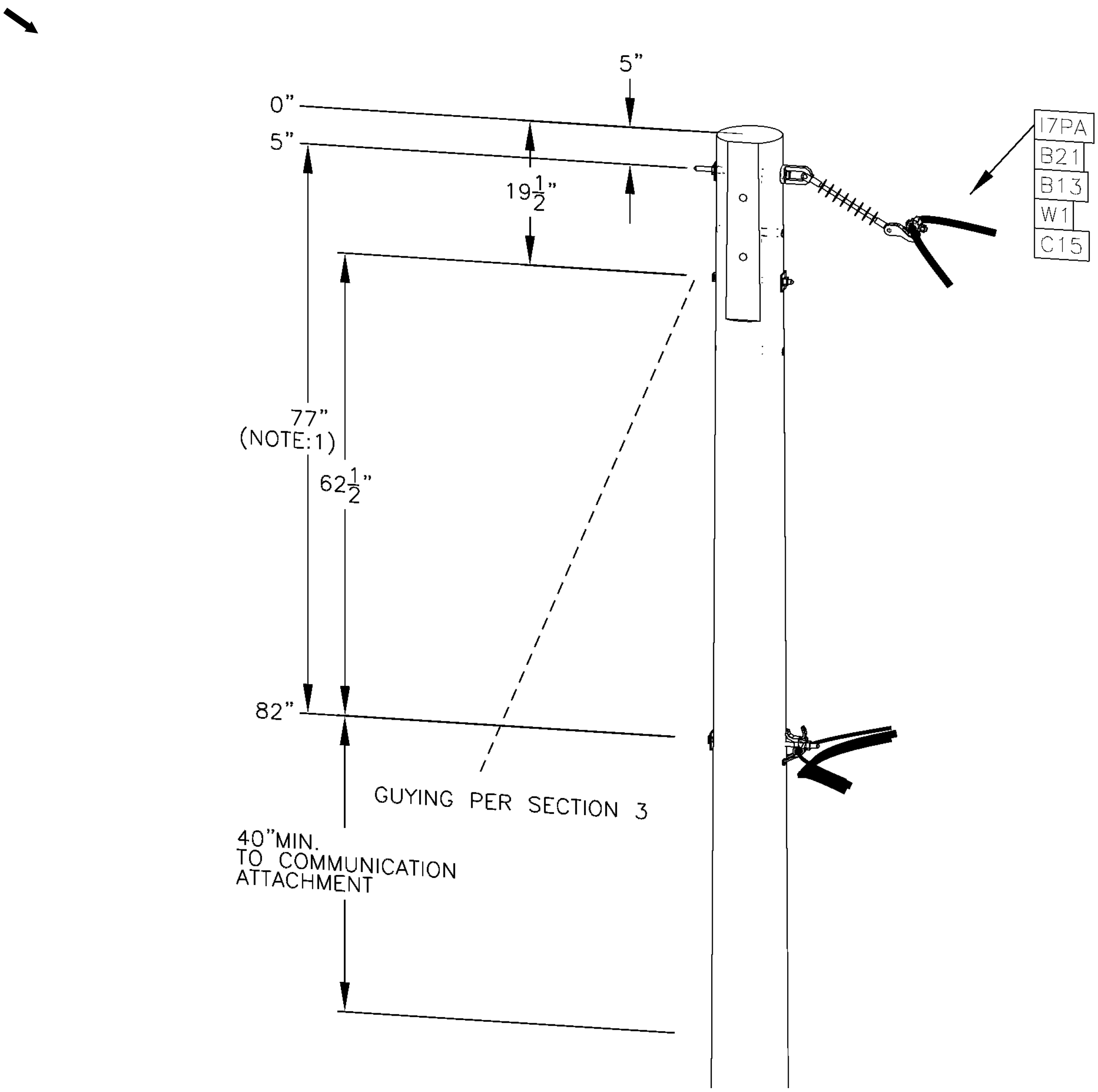


SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS									
SPANS WITH 1/0 TRIPLEX SEC					SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE 1/0 AAAC	MAIN LINE 336.4 AAC	MAIN LINE 477 AAC	SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE 1/0 AAAC	MAIN LINE 336.4 AAC	MAIN LINE 477 AAC
81.5	40 JT-84"	135	126	106	81.5	40 JT-84"	130	105	100
81.5	45 JT-111"	220	--	--	106	45 JT-111"	240	--	--
97	45 JT-111"	--	185	--	108	45 JT-111"	--	170	--
100	45 JT-111"	--	--	180	108	45 JT-111"	--	--	162
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE									

1Φ ARMLESS POLE TOP – 0-15 kV
0˚ - 20˚ - DELTA

	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
ppl		9-712	7/17

MU = @9-713	0-15KV 1Φ - Bare	MU = @9-713CL	0-15KV 1Φ - Covered	
MU = @9-713F	0-15KV 1Φ - Bare	MU = @9-713FCL	0-15KV 1Φ - Covered	Fiberglass Pole



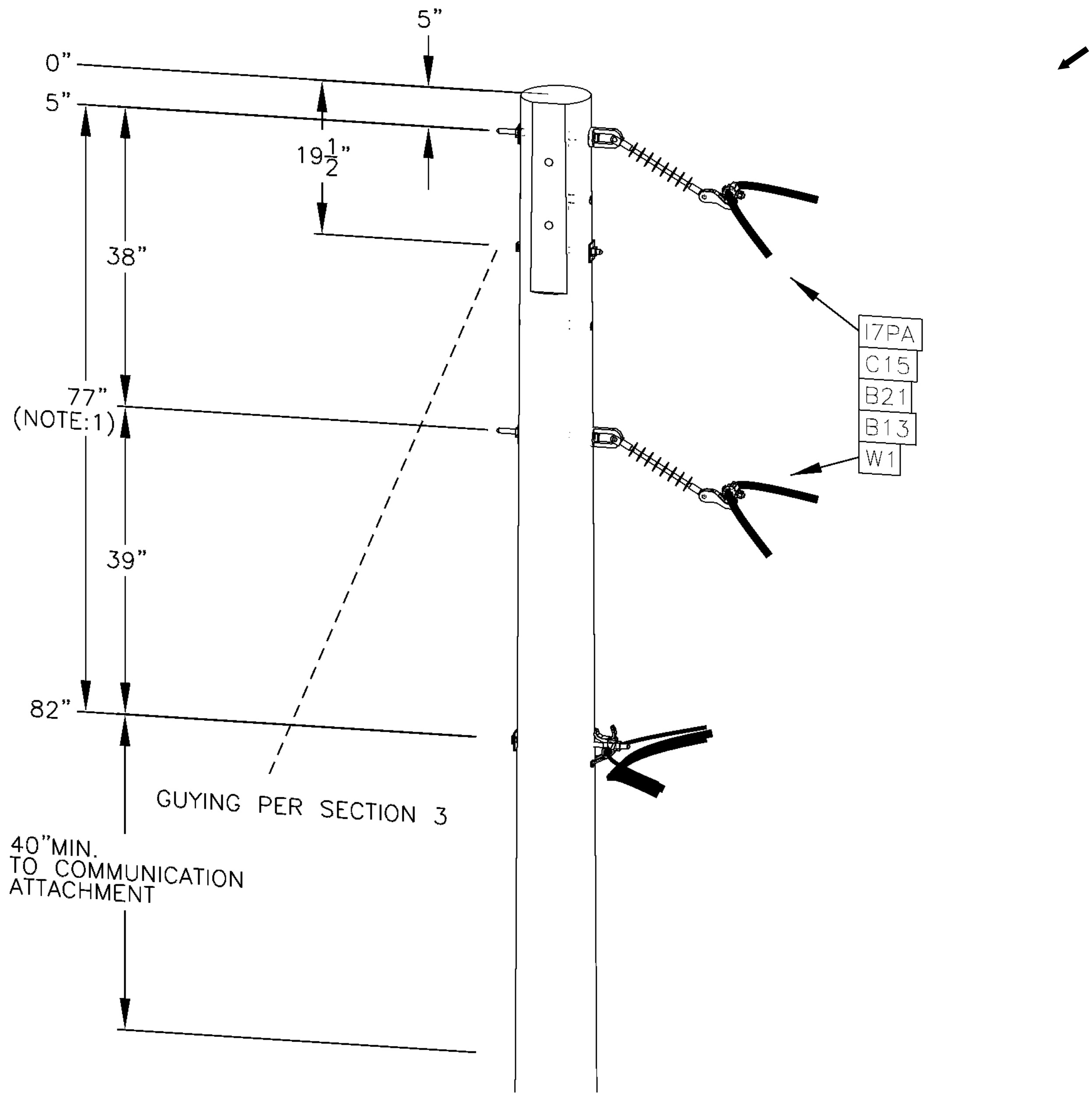
Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
82	40 JT-84"	135	135	135
82	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
82	40 JT-84"	225	190	180
83	45 JT-111"	300	--	--
106	45 JT-111"	--	240	--
108	45 JT-111"	--	--	230
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES:

1. This clearance can be reduced to a minimum of 65" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

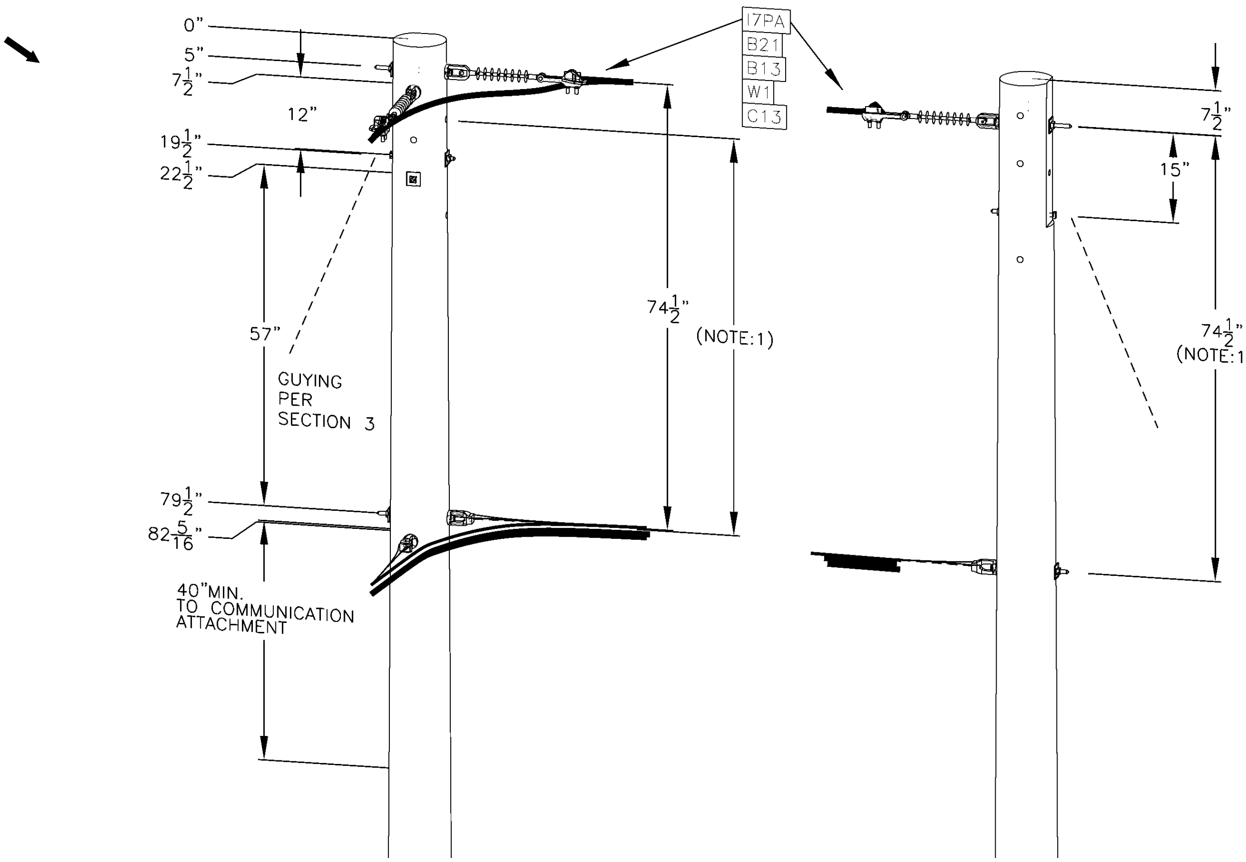
MU = @9-714	0-5KV 1Φ - Bare	MU = @9-714CL	0-5KV 1Φ - Covered	
MU = @9-714F	0-5KV 1Φ - Bare	MU = @9-714FCL	0-5KV 1Φ - Covered	Fiberglass Pole



Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS									
SPANS WITH 1/0 TRIPLEX SEC					SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC			1/0 AAAC	336.4 AAC	477 AAC
82	40 JT-84"	115	101	97	82	40 JT-84"	106	82	80
82	45 JT-111"	220	--	--	106	45 JT-111"	210	--	--
98	45 JT-111"	--	175	--	108	45 JT-111"	--	160	--
102	45 JT-111"	--	--	160	108	45 JT-111"	--	--	140
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE									

MU = @9-715A	0-15KV 1Φ - Bare	MU = @9-715ACL	0-15KV 1Φ - Covered	
MU = @9-715B	0-15KV 1Φ DE- Bare	MU = @9-715BCL	0-15KV 1Φ DE- Covered	
MU = @9-715AF	0-15KV 1Φ - Bare	MU = @9-715AFCL	0-15KV 1Φ - Covered	Fiberglass Pole
MU = @9-715BF	0-15KV 1Φ DE- Bare	MU = @9-715BFCL	0-15KV 1Φ DE- Covered	Fiberglass Pole



New Pole
61° - 90°
Single Phase
(9-715A)

New Pole
Deadend
Single Phase
(9-715B)

Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

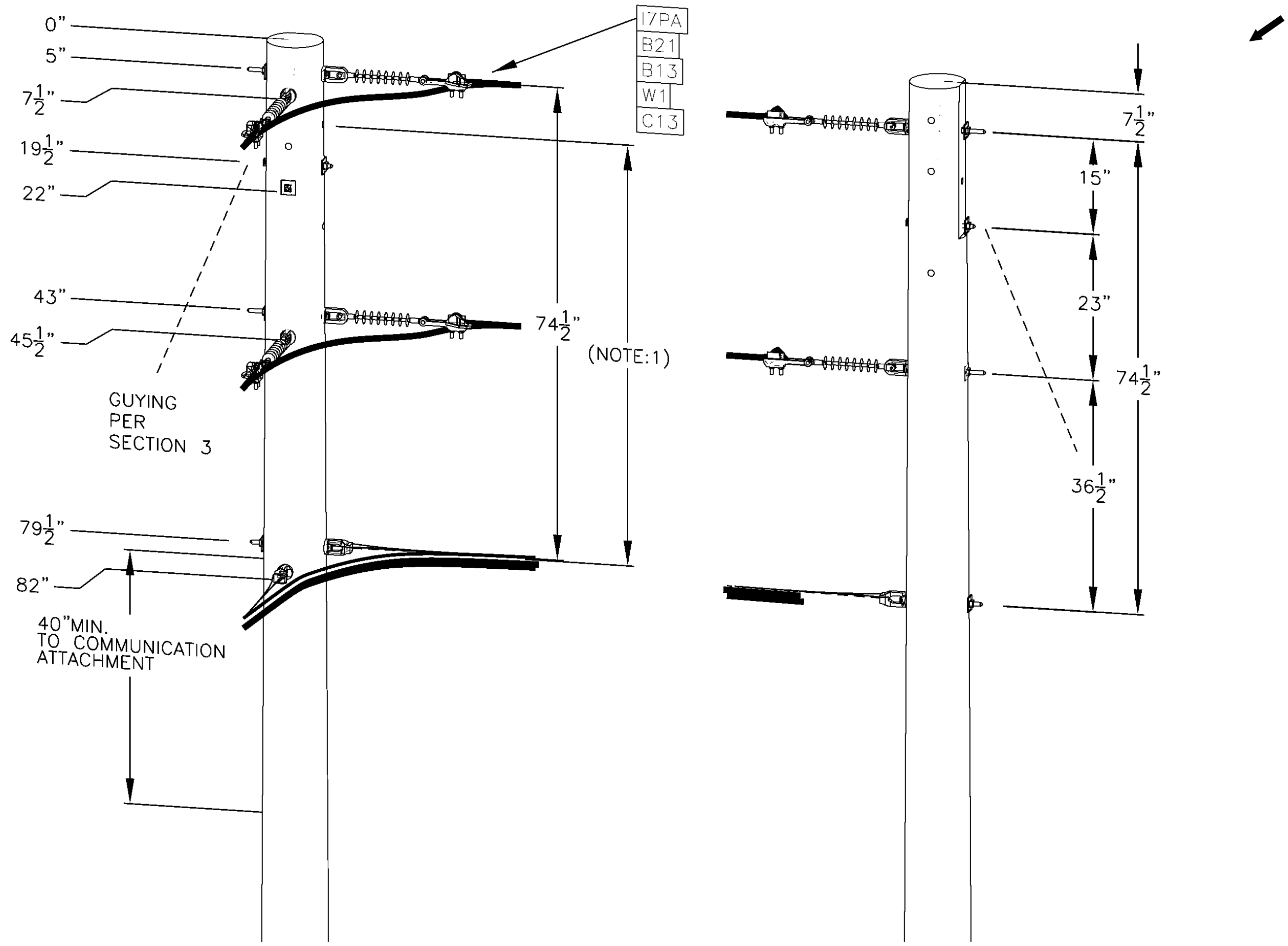
SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
82	40 JT-84"	135	135	135
82	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
82	40 JT-84"	225	185	175
86	45 JT-111"	300	--	--
105	45 JT-111"	--	235	--
107	45 JT-111"	--	--	225
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES:

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
2. This configuration can also be used for back-to-back (tangent) deadends.

MU = @9-716A	0-5KV 1Φ - Bare	MU = @9-716ACL	0-5KV 1Φ - Covered	
MU = @9-716B	0-5KV 1Φ DE- Bare	MU = @9-716BCL	0-5KV 1Φ DE- Covered	
MU = @9-716AF	0-5KV 1Φ - Bare	MU = @9-716AFCL	0-5KV 1Φ - Covered	Fiberglass Pole
MU = @9-716BF	0-5KV 1Φ DE- Bare	MU = @9-716BFCL	0-5KV 1Φ DE- Covered	Fiberglass Pole

Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

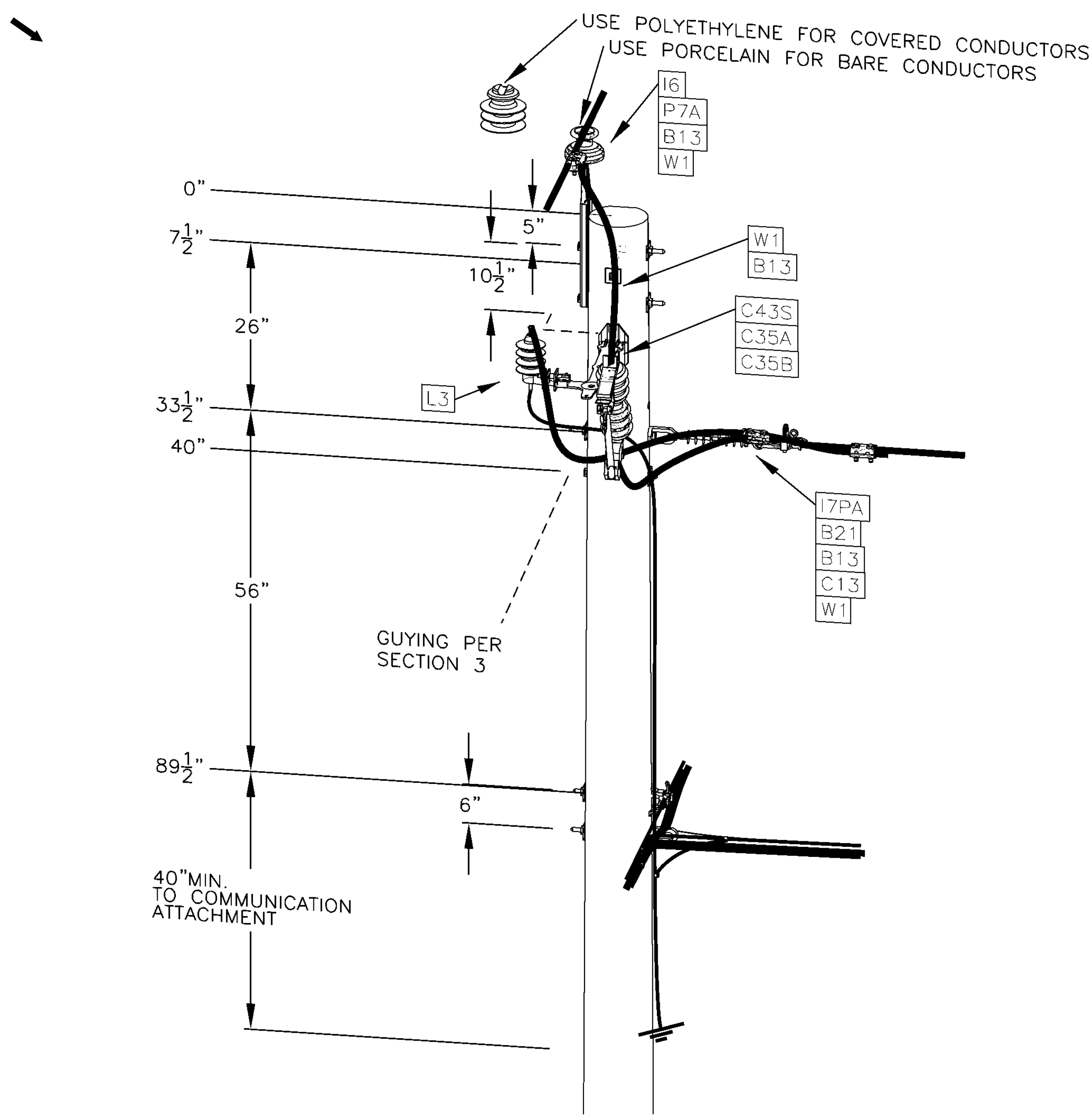


New Pole
61° - 90°
Single Phase
(Fig. 1A)

New Pole
Deadend
Single Phase
(Fig. 1B)

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS									
SPANS WITH 1/0 TRIPLEX SEC					SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE 1/0 AAAC	MAIN LINE 336.4 AAC	MAIN LINE 477 AAC	SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE 1/0 AAAC	MAIN LINE 336.4 AAC	MAIN LINE 477 AAC
82	40 JT-84"	128	88	85	82	40 JT-84"	101	78	76
83	45 JT-111"	210	--	--	108	45 JT-111"	210	--	--
88	45 JT-111"	--	175	--	108	45 JT-111"	--	156	--
101	45 JT-111"	--	--	155	108	45 JT-111"	--	--	138
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE									

MU = @9-719	0-15KV 1Φ - Bare	MU = @9-719CL	0-15KV 1Φ - Covered	
MU = @9-719F	0-15KV 1Φ - Bare	MU = @9-719FCL	0-15KV 1Φ - Covered	Fiberglass Pole

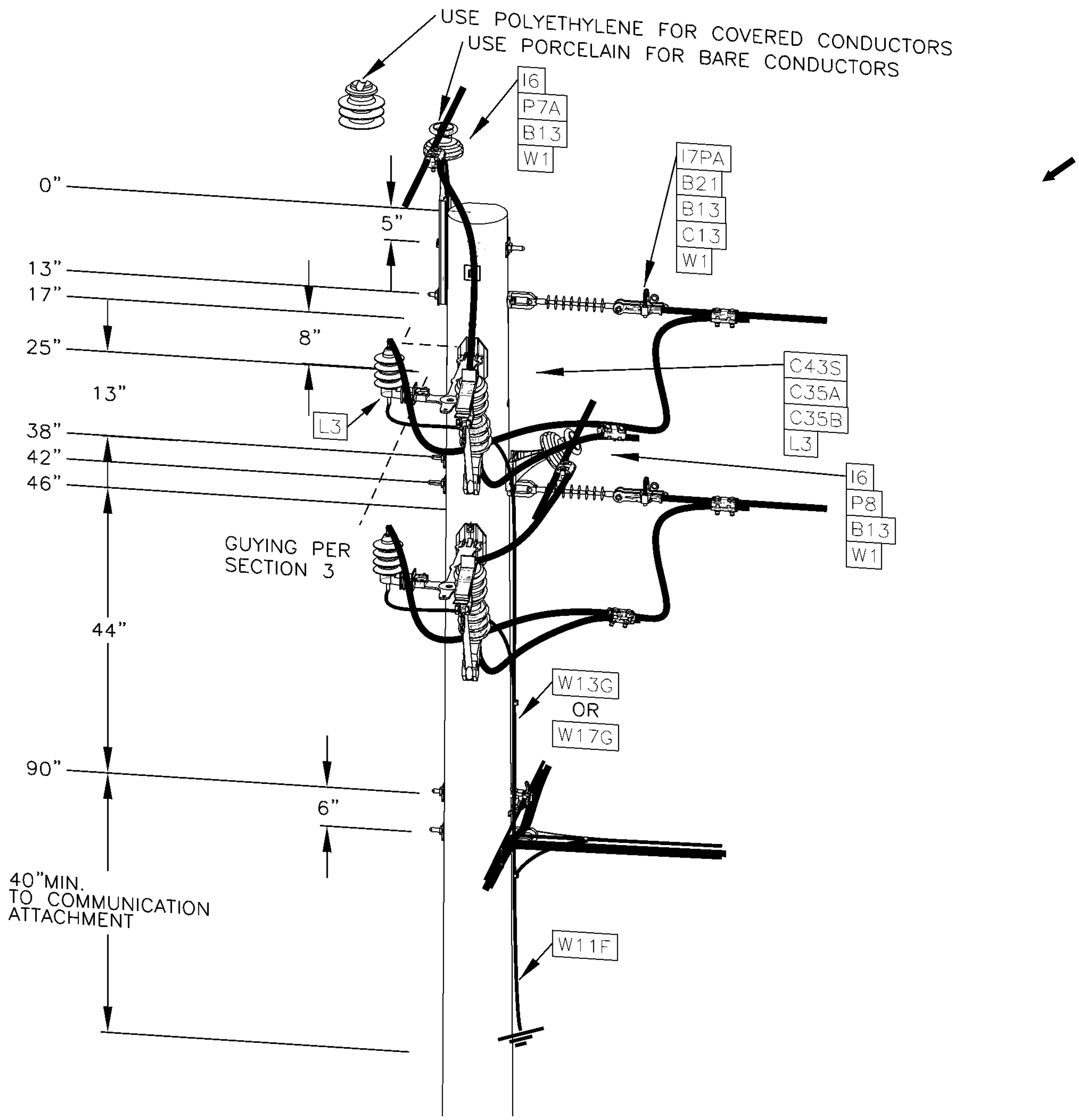


Supersedes 7/15 Issue – Update drawing with a 3-D rendering.

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
89.5	45 JT-111"	200	200	200	200
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
89.5	45 JT-111"	300	225	205	200
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

MU = @9-720	0-5KV 1Φ - Bare	MU = @9-720CL	0-5KV 1Φ - Covered	
MU = @9-720F	0-5KV 1Φ - Bare	MU = @9-720FCL	0-5KV 1Φ - Covered	Fiberglass Pole

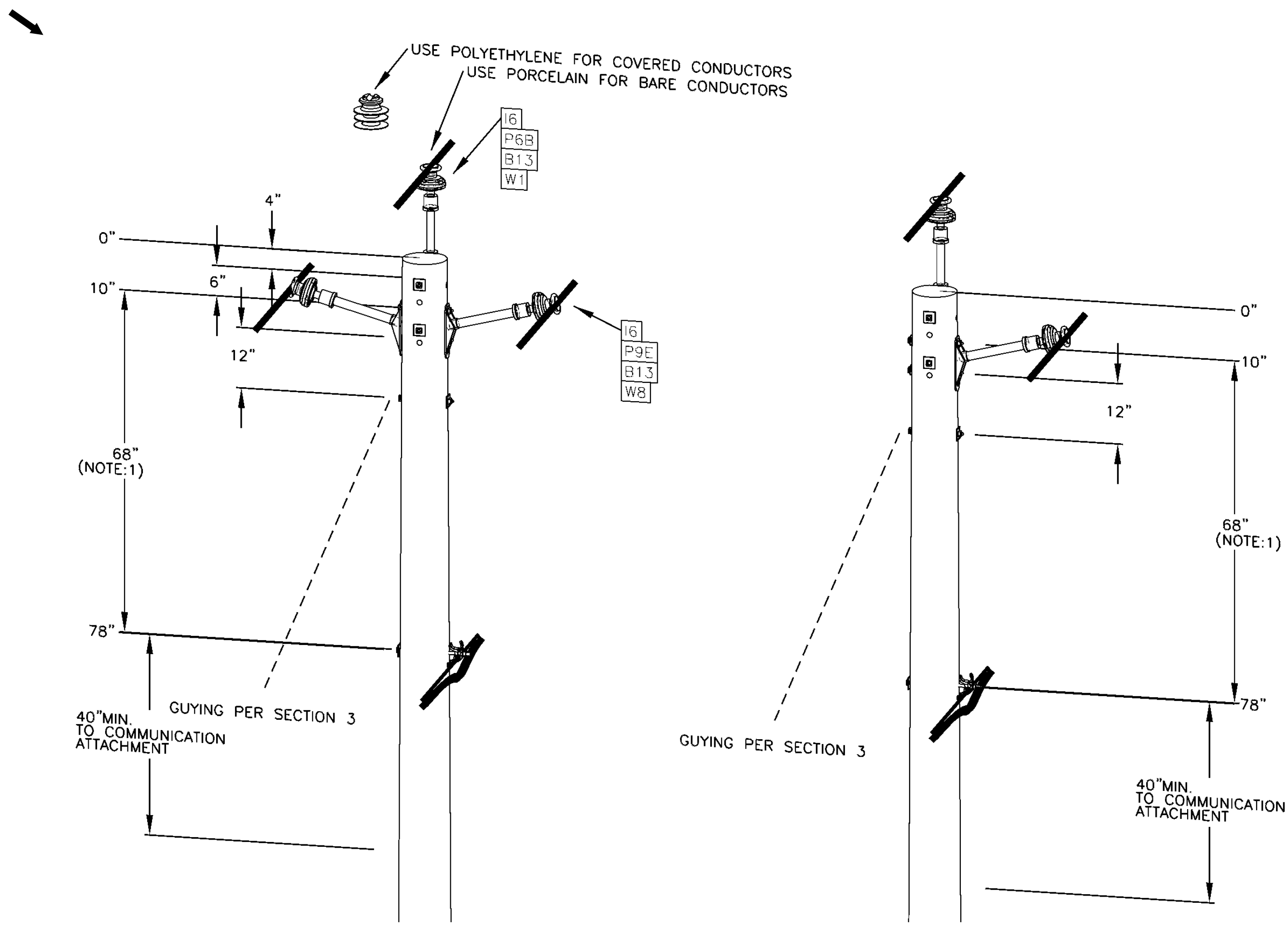
Supersedes 7/11 Issue – Update drawing with a 3-D rendering.



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
82	40 JT-84"	131	127	121	131
82	45 JT-111"	218	--	--	--
98	45 JT-111"	--	185	--	--
98	45 JT-111"	--	--	175	--
82	45 JT-111"	--	--	--	157
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
82	40 JT-84"	132	102	100	107
107	45 JT-111"	240	--	--	--
109	45 JT-111"	--	180	--	--
109	45 JT-111"	--	--	162	--
107	45 JT-111"	--	--	--	230
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

1Φ ARMLESS POLE TOP – 0-15 kV
0˚ - 20˚ – TAP TO 1Φ ARMLESS - DELTA

MU = @9-811A	0-15KV 3Φ - Bare	MU = @9-811ACL	0-15KV 3Φ - Covered
MU = @9-811B	0-15KV 3Φ - Bare	MU = @9-811BCL	0-15KV 3Φ - Covered



Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
78	40 JT-84"	N/A	N/A	N/A
78	45 JT-111"	N/A	N/A	N/A
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
78	40 JT-84"	N/A	N/A	N/A
78	45 JT-111"	N/A	N/A	N/A
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

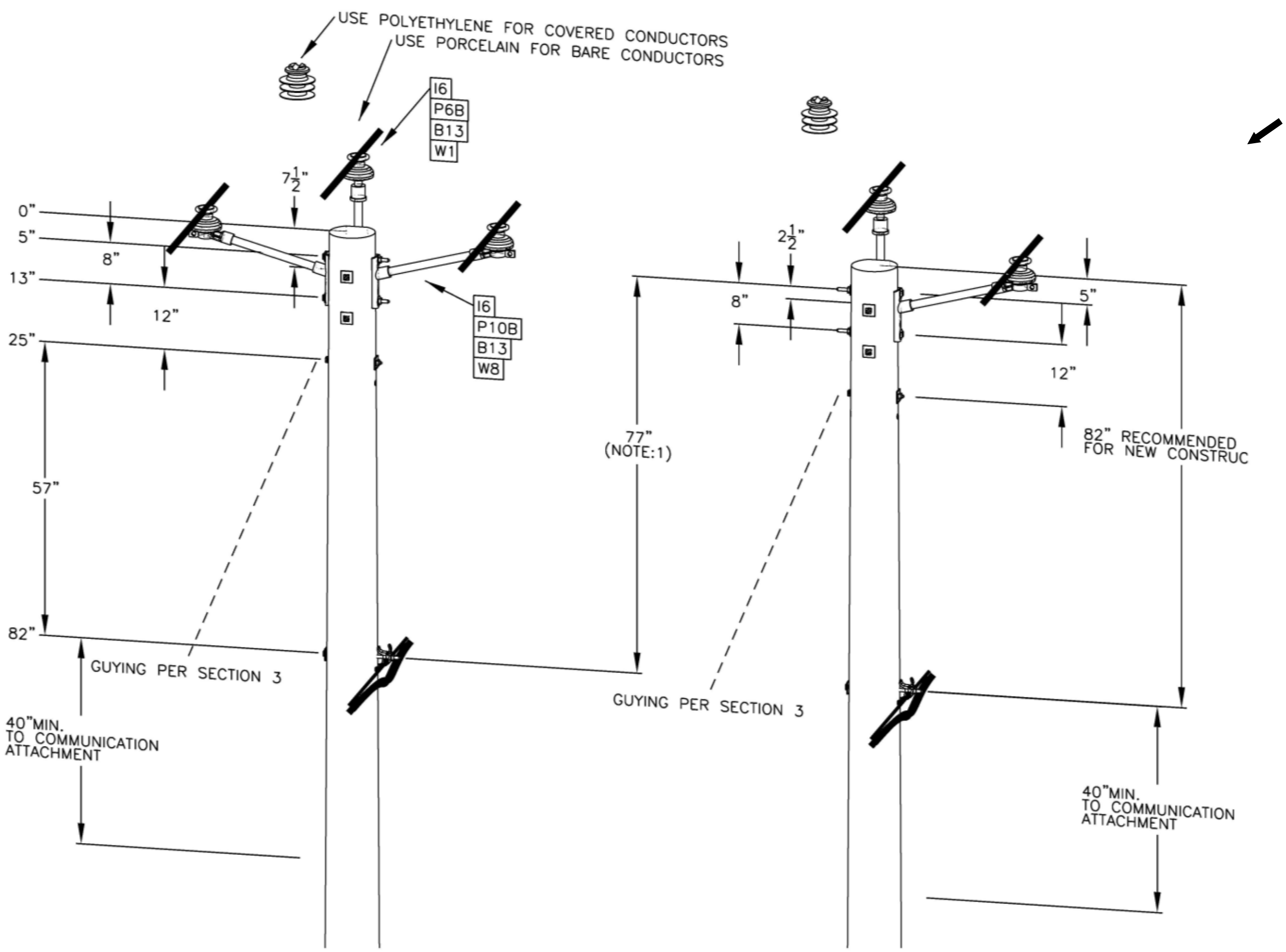
THIS DRAWING IS FOR MAINTENANCE PURPOSES ONLY

For new construction, see Drawing 9-812

NOTES:

1. This clearance can be reduced to a minimum of 56” if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

MU = @9-812A	0-15KV 3Φ - Bare	MU = @9-812ACL	0-15KV 3Φ - Covered	
MU = @9-812B	0-15KV 1Φ - Bare	MU = @9-812BCL	0-15KV 1Φ - Covered	
MU = @9-812AF	0-15KV 3Φ - Bare	MU = @9-812AFCL	0-15KV 3Φ - Covered	Fiberglass Pole
MU = @9-812BF	0-15KV 1Φ - Bare	MU = @9-812BFCL	0-15KV 1Φ - Covered	Fiberglass Pole



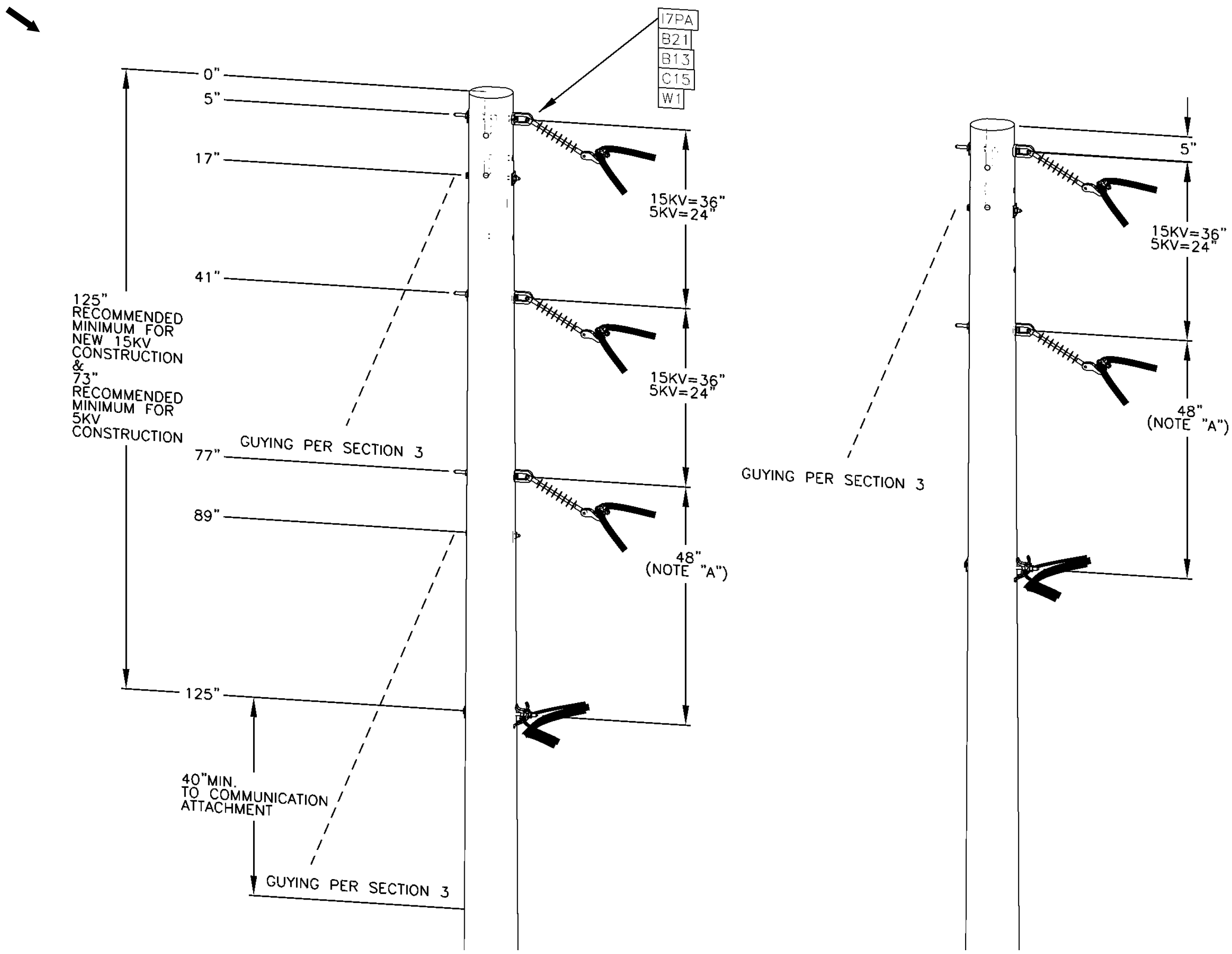
Supersedes 7/16 Issue – Corrected standoff from P10E to P10B.

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
82	40 JT-84"	131	131	131
82	45 JT-111"	218	218	218
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
82	40 JT-84"	221	206	187
82	45 JT-111"	300	--	--
102	45 JT-111"	--	250	--
107	45 JT-111"	--	--	235
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

NOTES:

1. This clearance can be reduced to a minimum of 56" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).

MU = @9-813A	0-15KV 3Φ - Bare	MU = @9-813ACL	0-15KV 3Φ - Covered	
MU = @9-813B	0-15KV 1Φ - Bare	MU = @9-813BCL	0-15KV 1Φ - Covered	
MU = @9-813AF	0-15KV 3Φ - Bare	MU = @9-813AFCL	0-15KV 3Φ - Covered	Fiberglass Pole
MU = @9-813BF	0-15KV 1Φ - Bare	MU = @9-813BFCL	0-15KV 1Φ - Covered	Fiberglass Pole



Supersedes 7/11 Issue – Update drawing with a 3-D rendering.

MAINTENANCE PURPOSES ONLY

Three-phase vertical construction shown in the figure above is not the preferred construction method. New line construction (including line extensions and taps) shall use crossarms, epoxy standoff insulator pins, or spacer cable configuration. Single phase delta vertical construction may be used only when no other options are feasible.

SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
125	45 JT-125"	131	131	112
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
125	45 JT-125"	152	110	105
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

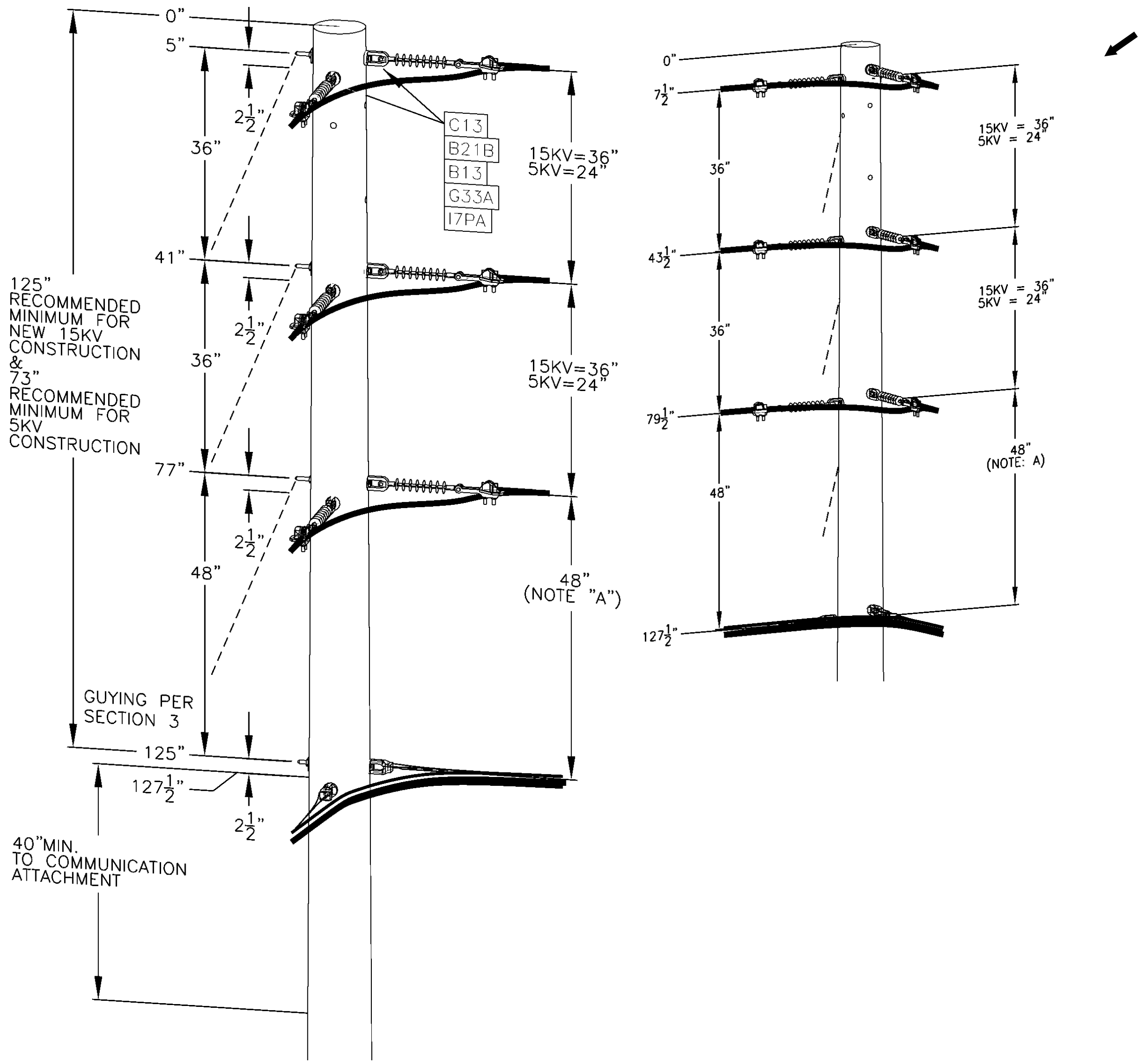
Note A

MINIMUM DIMENSIONS	
5KV OPERATION	20"
NEUTRAL ONLY-15KV OPERATION	20"
600V SECONDARY-15KV	48"

1Φ (DELTA) AND 3Φ **(MAINTENANCE ONLY)**ARMLESS POLE TOP – 0-15 kV
21°- 60°

MU = @9-814A	0-15KV 3Φ - Bare	MU = @9-814ACL	0-15KV 3Φ - Covered	
MU = @9-814AF	0-15KV 3Φ - Bare	MU = @9-814AFCL	0-15KV 3Φ - Covered	Fiberglass Pole

Supersedes 7/17 Issue – Corrected MU names.



Note A

MINIMUM DIMENSIONS	
5KV OPERATION	20"
NEUTRAL ONLY-15KV OPERATION	20"
600V SECONDARY-15KV	48"

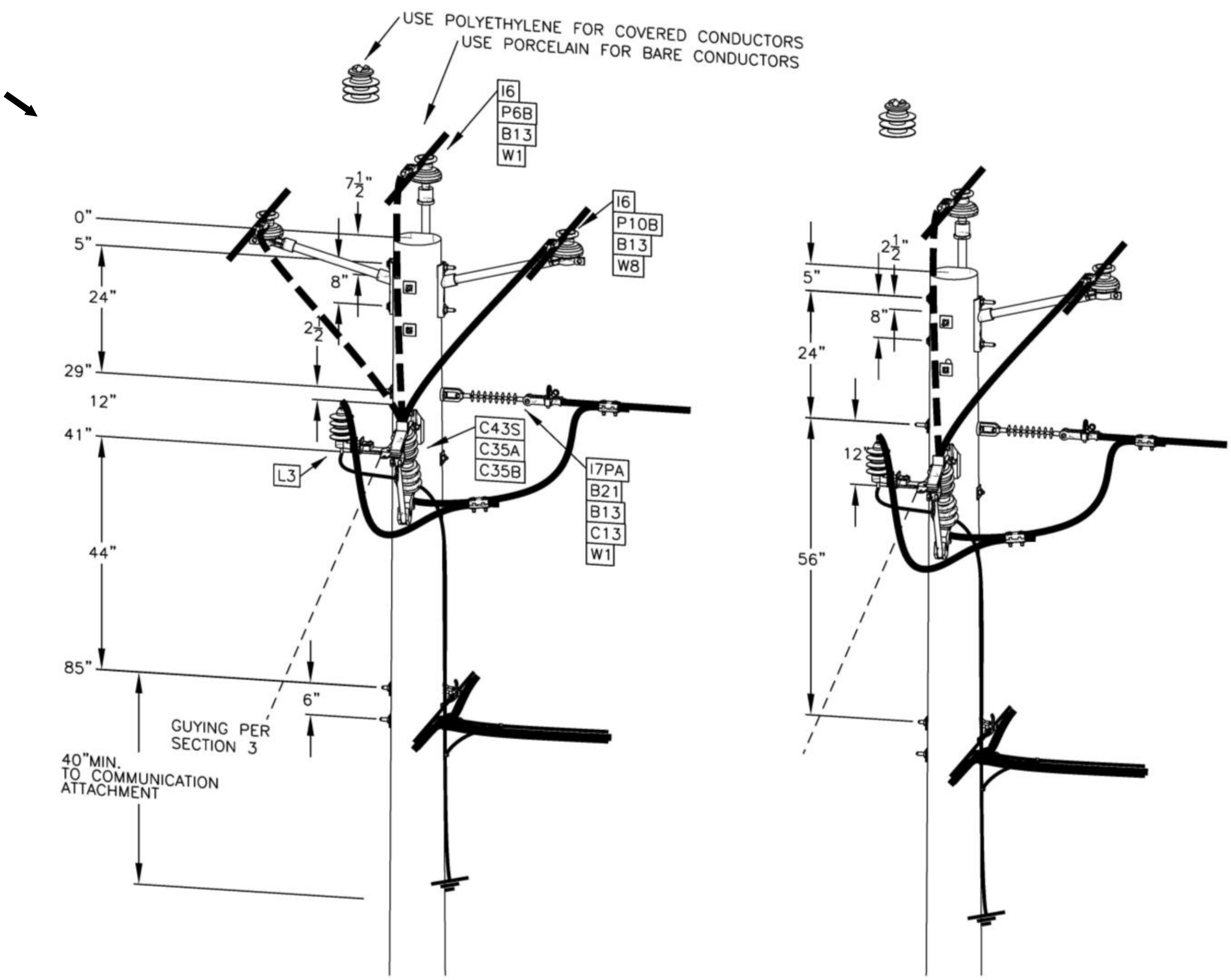
SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
127.5	45 JT-127.5"	131	131	112
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
127.5	45 JT-127.5"	152	110	105
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

MAINTENANCE PURPOSES ONLY

Three-phase vertical construction shown on this drawing is not the preferred construction method. New line construction (including line extensions and taps) shall use crossarms, epoxy standoff insulator pins, or spacer cable configuration. Single phase delta vertical construction may be used only when no other options are feasible.

3Φ ARMLESS POLE TOP – 0-15 kV 61°- 90° AND DEADEND **(MAINTENANCE ONLY)**			
ppl	**OVERHEAD CONSTRUCTION STANDARD**	**PAGE NUMBER** **9-814**	**ISSUE** **7/19**

MU = @9-823A	0-15KV 3Φ - Bare	MU = @9-823ACL	0-15KV 3Φ - Covered	
MU = @9-823B	0-15KV 1Φ - Bare	MU = @9-823BCL	0-15KV 1Φ - Covered	
MU = @9-823AF	0-15KV 3Φ - Bare	MU = @9-823AFCL	0-15KV 3Φ - Covered	Fiberglass Pole
MU = @9-823BF	0-15KV 1Φ - Bare	MU = @9-823BFCL	0-15KV 1Φ - Covered	Fiberglass Pole



Supersedes 7/16 Issue – Corrected standoff from P10E to P10B.

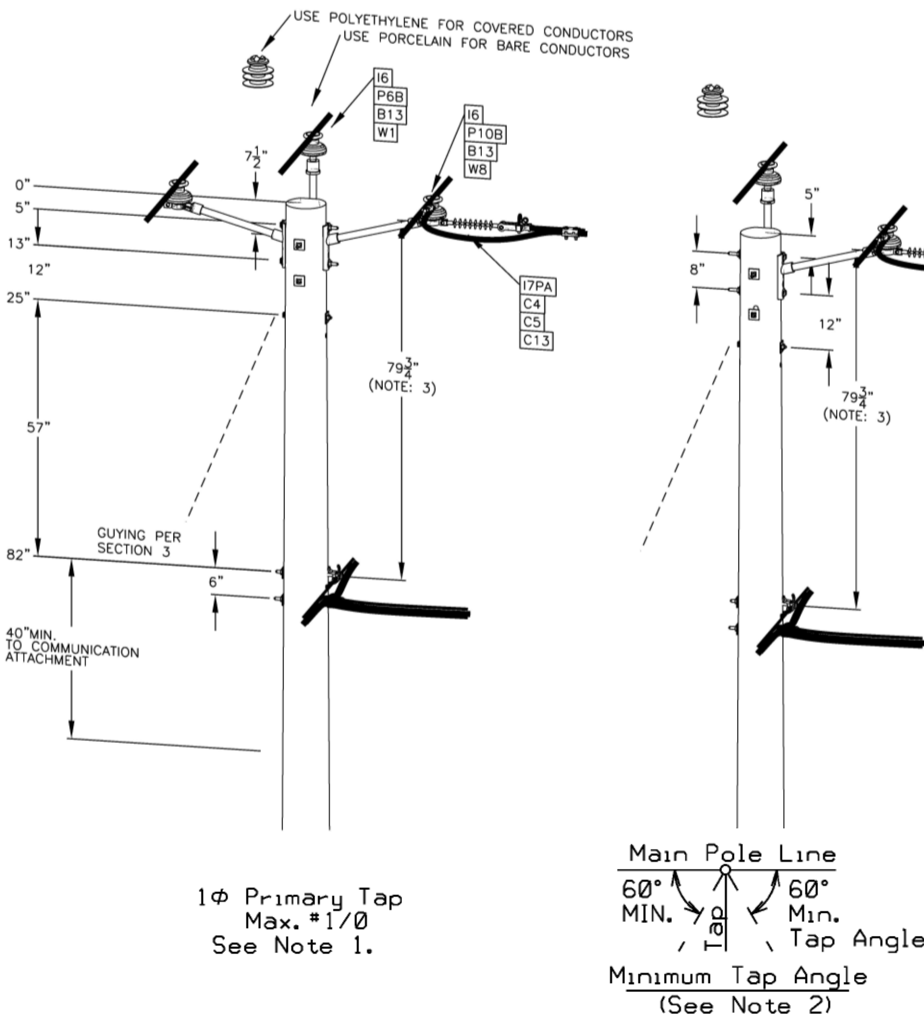
SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
85	45 JT-111"	209	209	209	209
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
86	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
107	45 JT-111"	--	--	235	--
86	45 JT-111"	--	--	--	200
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

Supersedes 7/08 Issue - drawing no longer needed - refer to 9-835.

Drawing 9-824 has been removed.

Refer to Drawing 9-835.

MU = @9-825A	0-15KV 3Φ - Bare	MU = @9-825ACL	0-15KV 3Φ - Covered	
MU = @9-825B	0-15KV 1Φ - Bare	MU = @9-825BCL	0-15KV 1Φ - Covered	
MU = @9-825AF	0-15KV 3Φ - Bare	MU = @9-825AFCL	0-15KV 3Φ - Covered	Fiberglass Pole
MU = @9-825BF	0-15KV 1Φ - Bare	MU = @9-825BFCL	0-15KV 1Φ - Covered	Fiberglass Pole



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
82	40 JT-84"	131	131	131	137
82	45 JT-111"	218	218	218	220
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
82	40 JT-84"	221	206	187	230
82	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
107	45 JT-111"	--	--	235	--
82	45 JT-111"	--	--	--	300
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

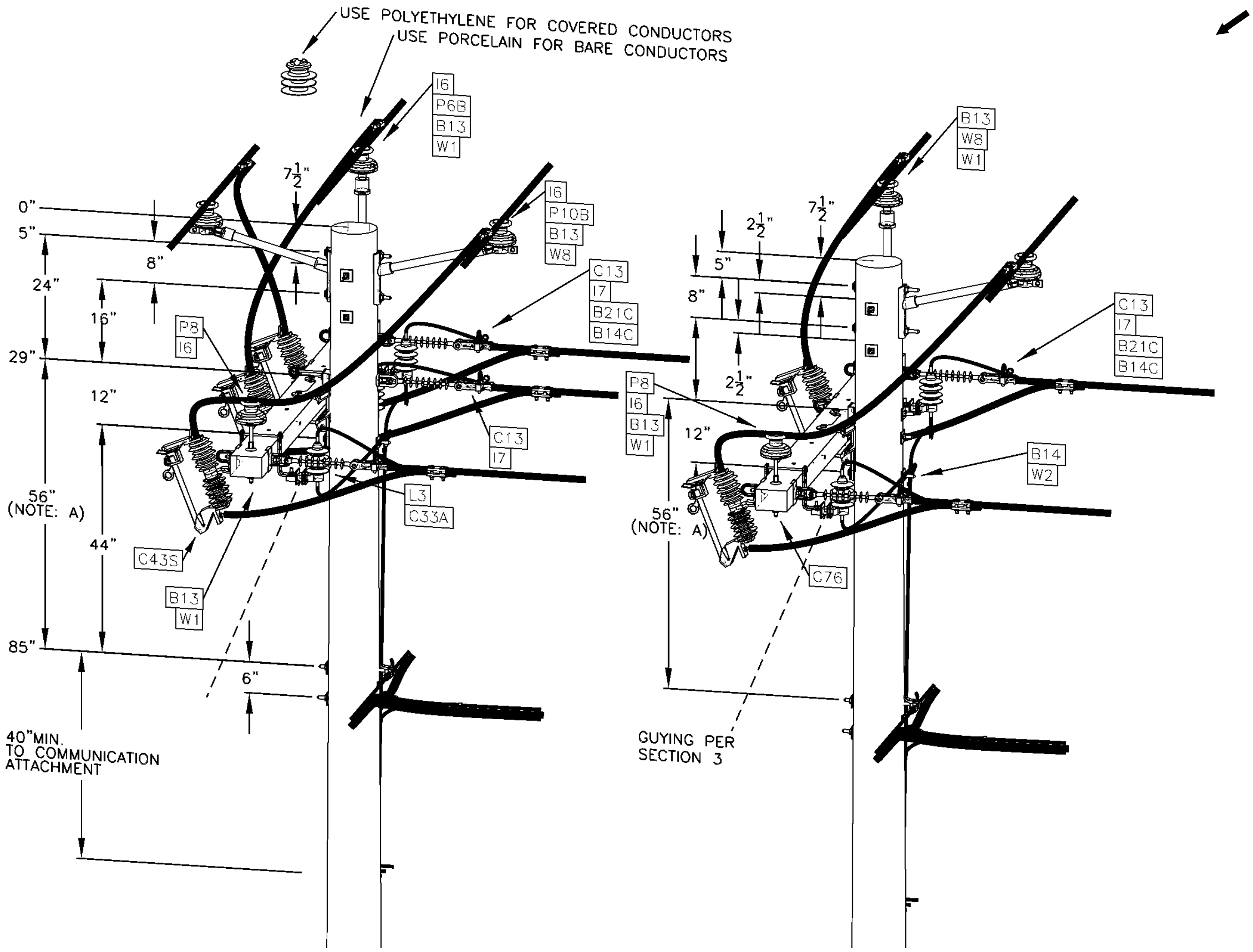
NOTES:

1. Tap shall be single-phase and have a 1/0 maximum conductor size.
2. Tap circuit angle shall be not less than 60° off main pole line (see detail above).
3. This clearance can be reduced to a minimum of 56" if needed and if NESC midspan clearances are maintained (see Section 7.11 for required midspan clearances).
4. This configuration may only be used when the configuration of drawing 9-823 is not feasible. If this configuration is used, the fused cutout and arrester for the tap **must** be placed on the next pole down the tap.

Supersedes 7/16 Issue – Corrected standoff from P10E to P10B and corrected Note 4.

MU = @9-835A	0-15KV 3Φ - Bare	MU = @9-835ACL	0-15KV 3Φ - Covered	
MU = @9-835B	0-15KV 1Φ - Bare	MU = @9-835BCL	0-15KV 1Φ - Covered	
MU = @9-835AF	0-15KV 3Φ - Bare	MU = @9-835AFCL	0-15KV 3Φ - Covered	Fiberglass Pole
MU = @9-835BF	0-15KV 1Φ - Bare	MU = @9-835BFCL	0-15KV 1Φ - Covered	Fiberglass Pole

Supersedes 7/14 Issue – Update drawing with a 3-D rendering.



SEE 9-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS					
SPANS WITH 1/0 TRIPLEX SEC					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
85	45 JT-111"	209	209	209	209
SPANS WITH 1/0 AAAC NEUTRAL					
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE			TAP
		1/0 AAAC	336.4 AAC	477 AAC	1/0 AAAC
86	45 JT-111"	300	--	--	--
102	45 JT-111"	--	250	--	--
107	45 JT-111"	--	--	235	--
86	45 JT-111"	--	--	--	200
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE					

Version	Date	Modification	Author(s)	Approval by (Name/Title)
12	7/21	• Corrected drawing titles on pages 9-415F, 9-416F, 9-417, and 9-417F. • Corrected formatting on pages 9-413 through 9-450.		
11	7/20	• Corrected reference to NESC rule in Section 9.2.20 • Moved guy details for fiberglass poles to Section 3 on drawings 9-411F, 9-413F, 9-415F, and 9-416F. • Modified center string deadend connection on drawings 9-415 and 9-415F.		
10	7/19	• Correct ruling span length and table reference in step 5 of sample calculations on page 9-204. • Added new drawing 9-411C. • Corrected MUs on 9-413F. • Added new drawing 9-450.		
9	7/18	• Editorial modifications in 9.3.20. • Revise 9.3.30 to allow tree wire with armless construction. • Correct 9-115 by removing figure-8 chain link in two figures. • Revise example calculations on pages 9-200 through 9-205.		
8	7/17	• In 9.2.20(E), revised the use of double wood crossarms and fiberglass crossarms. Revise • On 9-814, deleted single phase MUs. • On 9-825, corrected Note 4. • Corrected part call outs on 9-419 Fig 1, 9-421 Fig 2, 9-423 Fig 2, 9-812, 9-823 and 9-825.		

Version	Date	Modification	Author(s)	Approval by (Name/Title)
7	7/16	• Add information for isolating circuits of different voltages – new section 9.5.70 and new drawing 9-207. • Replace structure drawings with 3-D renderings. • Correct alley arm brace material call out on 9-437 through 9-440.		
6	7/15	• In 9.3.60, changed "#4 or smaller" to "smaller than #2" to match 9.1.30(B). • Information on insulator replacements during conversions was added to Section 9.6.10. • Corrected mounting bolt on 9-415, 9-415F, 9-417F, 9-419 and 9-421. • Corrected issue date on 9-435. • Corrected bracket location on 9-719.		
5	7/14	• In 9.3.10, clarified text. • Replaced double wood deadend crossarms with fiberglass deadend crossarm assemblies in 9-415, 9-416, 9-417, 9-422, 9-424, 9-435 and 9-835. • Corrected materials in 9-416F. • Added I24 as spacer over deadend arm in 9-415F.		
4	7/13	• Moved arresters to lower crossarms on 9-422, 9-424 and 9-435		
3	7/12	• Updated voltage regulation limits in Section 9.1.40.		

Version	Date	Modification	Author(s)	Approval by (Name/Title)
2	7/11	• Added (required) cutout(s) and arrester(s) to most tap drawings • Removed guy wire materials - refer to Section 3 for guying materials and CUs • Removed Drawing 9-420 - refer to Drawing 9-435 for new construction. • Removed Drawing 9-824 - refer to Drawing 8-435 for new construction. • Corrected drawing titles of those showing single phase delta taps. • Labeled vertical construction drawings as "Maintenance Only" as this is not the preferred construction method for new lines.		
1	07/08	• New construction drawings for Fiberglass Construction: 9-411F, 9-413F, 9-415F, 9-417F. • Added fiberglass MU information: 9-711, 9-712, 9-713, 9-714, 9-715, 9-716, 9-719, 9-720, 9-812, 9-813, 9-814, 9-823, 9-824, 9-825, 9-835.		

10.0 GENERAL

The following STANDARDS section applies to new installation of overhead secondary conductors.

In cases where existing secondary conductors are deteriorated, clearances are doubtful, or poles need replacement, consideration should be given to rebuilding the entire secondary in accordance with these Standards.

10.0.10 Secondary "CRIB"

Secondary "CRIB" describes the overhead secondary supply conductors, typically 120/240 volt, that are supplied by a distribution transformer located near the load mid-point and that supply individual service drop cables along its route.

10.0.20 Secondary Voltages

See STANDARDS section 11 for available secondary voltages.

10.0.30 Conductors

The Standard single phase, secondary crib cable is a 1/0-3/C aluminum cable consisting of one base aluminum alloy neutral messenger and two aluminum cable covered conductors continuously wrapped around the neutral messenger. Applications for this cable include residential, industrial, commercial, and outdoor lighting.

Quadruplex cables shall be used for all 120/208 V, 277/480 V effectively grounded and 240 V and 480 V not effectively grounded secondaries.

For line currents greater than 245 amps., use 4/C 336.4 kCMIL secondary cable.

10.0.40 Conductor Location

In general, secondary conductors shall normally be installed on the street or highway side of the pole. On inside angles, it may be necessary or preferable to attach secondary conductors on the field side of the pole. "Boxing" in a pole by installing secondary cable on the opposite side from that of communication conductors should be avoided.

For rack construction, the neutral shall be located on the top spool of the rack. The grounded conductor of a 3 phase Delta secondary shall be installed in the top position on the power secondary rack. This grounded phase conductor shall not be used as a system neutral nor shall a system neutral be used as the grounded phase conductor.

When two or more secondary circuits are located on the same pole, the following order is recommended from the top: single phase secondary; 3-phase, 4 wire secondary; 3-phase, 3 wire secondary; and multiple street lighting.

All grounded neutrals (except secondary neutrals of not effectively grounded primary systems), located on the same pole shall be bonded together.

Supersedes 01/06 Issue – General Revision

10.0.50 **Clearances**

See Section 7-Clearances for specific details.

Span taps should be made where practical to provide adequate clearance, climbing, and working space on the pole. An extension bracket (Std. Item A50E) may be used with triplex to improve clearances and climbing space, or to avoid trees.

10.0.60 **Sags and Tension**

See Pages 10-5 and 10-6 for sags and tensions.

10.0.70 **Taps and Connections**

See STANDARDS Section 5-“Connectors” for taps, connections and methods of covering connections.

10.0.80 **Tree Trimming**

Although secondary cables require a relatively small clearance from trees, they are not designed to withstand abrasion from continual contact with tree limbs.

10.0.90 **Secondary Cable Dimensions**

See STANDARDS Section 11 – “Services” – page 11-62, for secondary and service drop cable dimensional data.

10.1 SECONDARY CRIB DESIGN

Good secondary crib design is dependent on knowledge of load. Actual load checks furnish the most accurate information about existing loads and should be used whenever practical. Other tools such as GIS data are also available to accurately estimate existing loads.

Good secondary crib design also includes provisions for future load growth. Adherences to the principles in this STANDARD will result in secondary that can grow substantially without major rebuilding.

Gaps between adjacent secondary cribs should be filled in with secondary cable when the gap is less than 400-feet in length. For longer gaps, install a standard 1/0 aluminum neutral conductor only, unless future load growth is expected within the area of the gap.

Proper balance must be maintained between length of secondaries, size of conductors, loading of transformers, and overall voltage regulation in service drop, secondary, and transformer installations.

Proper secondary crib design will take into account all of the following:

10.1.10 Transformer Location – Good secondary crib design will place the distribution transformer in the physical center of the secondary crib run. Adjustments can be made to favor the electrical center of the load, or accommodate other existing pole top equipment.

10.1.20 Transformer KVA Size –A typical residential secondary crib will have one of three basic load profiles:
1. Oil or Gas Heat – 8kW diversified per residence (includes electric range, dryer, and window air conditioner units)
2. Oil or Gas Heat w/ Central Air – 10kW per residence

Supersedes 7/12 Issue – Revised 10.0.70 to taping connections option and renumbered 10.0.60 through 10.0.90.

3. Electric Heat – 20kW per residence

The following Table provides a guide to determine the maximum number of residential customers that can be served by a secondary crib. (assumes single family homes less than 3,500 square feet and multi-family homes)

Table 1

Maximum Number of Residential Customers				
Transformer KVA Size	**Oil or Gas Heat**	**Oil or Gas Heat w/ Central Air**	**Electric Heat**	**50% Electric Heat 50% Oil/Gas Heat**
25 KVA	9	5	2	3
50 KVA	12	8	5	6

10.1.30 **Length of Secondary Crib -** Transformer KVA size, transformer location, secondary crib load, and voltage drop shall determine the length of secondary crib. For evenly distributed loads, the following Table serves as a guide to determine the approximate length of a straight, 2-way 1/0 triplex secondary to provide a 1.5% voltage drop at the ends with the transformer located in the center.

Table 2

Total KVA Load	Total Length of Secondary	Length of Secondary from Transformer to End
15 kVA	1000 feet	500 feet
25 kVA	700 feet	350 feet
50 kVA	350 feet	175 feet

10.1.40 **Voltage Drop** – Voltage drop in secondary cribs should be limited to 1.5% in areas where new load growth can reasonably be expected. In areas where new load growth is not expected, this may be increased to a maximum of 3% of nominal (120V). A voltage drop calculator is available on the PPL Distribution Engineering Services website.

10.1.50 **Flicker** - Consider only the part of the secondary which is to be checked for flicker voltage drop. Determine the kW-Ft and the power factor for the fluctuating load. From the diagram on Page 10-9 determine the kW-Ft that will result in 1% drop.

Divide the kW-Ft by the value found and the quotient will be the percent drop as shown above. While this method is not strictly accurate, the error is in the safe side and it should serve for most problems. For more accurate results calculate load, power factor, and voltage drop before and after adding fluctuating load.

10.1.60 **Commercial or Industrial Secondaries**

In planning commercial and industrial secondaries, consider the overall voltage regulation in the service, secondary, transformer and primary rather than specifically limiting the drop in each of the parts.

The size of secondary and service wires should be determined by consideration of both voltage drop and current. Multiplex cables are recommended if current rating and voltage drops permit. Voltage drop on secondary and service should not exceed 3%. Current should not exceed the values shown in basic data for Section 6-Primary Conductors. It is generally economical to stay well below those values for everything except temporary work. In the case of intermittent loads, the above voltage limitations may be exceeded provided the resulting voltage is satisfactory.

Transformer loading should not exceed 100% of rating where the daily load factor is 100% and ambient temperature is 30°C/86°F or 0°C/32°F. However, loading may be increased 0.3% for each 1% decrease in load factor to a maximum of 115% of rating at 50% load factor. In addition, if peak loads occur at ambients other than 30°C/86°F or 0°C/32°F, loading may be increased 1% for each 1°C/34°F decrease or decreased 2% for each 1°C/34°F increase in ambient. The effects of load factor and temperature may be added to permit a maximum of 145% load with a load factor of 50% or less, at ambients of 0°C/32°F or below.

Starting currents and flicker voltage drops should be checked where applicable. Consult Pages 10-9 and 10-10 for further data on starting current and flicker limitations. Flicker should, in general, be kept below the borderline of irritation. However, avoid increasing the cost of an installation to reduce flicker if the customer should apply corrective measures to his load.

Supersedes 01/06 Issue – General Revision

3/c – 1/0 Aluminum Triplex Secondary Cable
Messenger 1/0 7 Strand 6201 or ACSR

TABLE 3
INITIAL SAGS AND TENSIONS – 150 FT. RULING SPAN – FOR INITIAL INSTALLATION ONLY

TEMP. (°F)	TENSION (LBS.)	SAG IN INCHES ACTUAL SPAN IN FEET				
		100	125	150	175	200
0	1495	4	7	10	13	17
30	1245	5	8	11	16	20
40	1165	5	9	12	17	22
50	1085	6	9	13	18	23
60	1010	6	10	14	19	25
70	940	7	11	15	21	27
80	875	7	11	16	22	29
90	805	8	12	18	24	31
100	745	8	13	19	26	34
120	640	10	15	22	30	39

MAXIMUM DESIGN SAGS AND TENSIONS – INITIAL

TEMP. (°F)	ICE (IN.)	WIND (PSF)	K (LF./FT.)	SAG (IN.)	TENSION (LBS.)
0	0.5	4.0	0.3	31	2000
32	0.5	0	0	29	1630
32	0	0	0	12	1225
120	0	0	0	22	640

TABLE 4
FINAL SAGS AND TENSIONS – 150 FT. RULING SPAN – FOR CLEARANCES PURPOSES ONLY

TEMP. (°F)	TENSION (LBS.)	SAG IN INCHES ACTUAL SPAN IN FEET				
		100	125	150	175	200
0	1250	5	8	11	15	20
30	975	6	10	15	20	26
40	895	7	11	16	22	29
50	820	8	12	18	24	31
60	745	8	13	19	26	34
70	690	9	14	21	28	37
80	635	10	16	23	31	40
90	580	11	17	24	33	44
100	535	12	18	26	36	47
120	470	13	21	30	41	54

MAXIMUM DESIGN SAGS AND TENSIONS – FINAL

TEMP. (°F)	ICE (IN.)	WIND (PSF)	K (LF./FT.)	SAG (IN.)	TENSION (LBS.)
0	0.5	4.0	0.3	32	1925
32	0.5	0	0	31	1505
32	0	0	0	15	955
120	0	0	0	30	470

Supersedes 01/06 Issue – Page shift due to general revisions.

3/c – 1/0 Aluminum Triplex Secondary Cable
Messenger 1/0 7 Strand 6201 or ACSR

TABLE 5
INITIAL SAGS AND TENSIONS – 200 FT. RULING SPAN – FOR INITIAL INSTALLATION ONLY

TEMP. (°F)	TENSION (LBS.)	SAG IN INCHES				
		ACTUAL SPAN IN FEET				
		150	175	200	225	250
0	1155	12	17	22	28	34
30	955	15	20	26	34	41
40	895	16	22	28	36	44
50	840	17	23	30	38	47
60	790	18	24	32	40	50
70	745	19	26	34	43	53
80	700	20	28	36	46	56
90	660	21	29	38	48	60
100	630	23	31	40	51	63
120	570	25	34	42	56	70

MAXIMUM DESIGN SAGS AND TENSIONS – INITIAL

TEMP. (°F)	ICE (IN.)	WIND (PSF)	K (LF./FT.)	SAG (IN.)	TENSION (LBS.)
0	0.5	4.0	0.3	56	2000
32	0.5	0	0	52	1600
32	0	0	0	26	955
120	0	0	0	45	570

TABLE 6
FINAL SAGS AND TENSIONS – 200 FT. RULING SPAN – FOR CLEARANCES PURPOSES ONLY

TEMP. (°F)	TENSION (LBS.)	SAG IN INCHES				
		ACTUAL SPAN IN FEET				
		150	175	200	225	250
0	965	15	20	26	33	41
30	775	18	25	32	41	51
40	725	20	27	35	44	54
50	680	21	28	37	47	58
60	640	22	30	39	50	62
70	605	26	32	42	53	65
80	575	25	34	44	56	69
90	545	26	35	46	59	73
100	520	27	37	49	61	76
120	475	30	41	53	67	83

MAXIMUM DESIGN SAGS AND TENSIONS – FINAL

TEMP. (°F)	ICE (IN.)	WIND (PSF)	K (LF./FT.)	SAG (IN.)	TENSION (LBS.)
0	0.5	4.0	0.3	56	1975
32	0.5	0	0	54	1530
32	0	0	0	33	765
120	0	0	0	53	475

Supersedes 01/06 Issue – Page shift due to general revisions.

Supersedes 07/09 Issue – Revised 10.3.30(D) to remove taping option for connectors.

10.3 1/0 - 3C ALUMINUM MAINLINE CONDUCTOR SPLICING

10.3.10 Application

This Section covers splicing 3/C – 1/0 secondary mains in the street. Splicing should not take place within 5 feet of any pole, to allow for multiple secondary services and streetlight.

10.3.20 Procedure – Initial Steps, Neutral Splicing

A. Cut conductors to give sleeve locations shown in Figure I below. **Note:** Total splicing length is about 36 inches.

B. Make certain ends are somewhat square and free of burrs.

C. Use **full tension automatic** splice**,** Std. Item S19K, on the neutral. **Make sure the neutral carries all the tension and the live legs are relatively slack when all splicing is complete.**

D. Follow manufacturer's splicing recommendations on splice packaging including wire brushing.

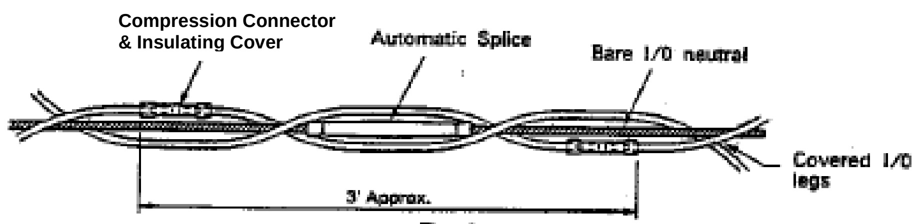
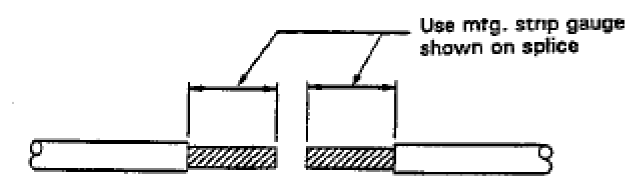


Fig. 1

10.3.30 Procedure – Leg Conductor Splicing

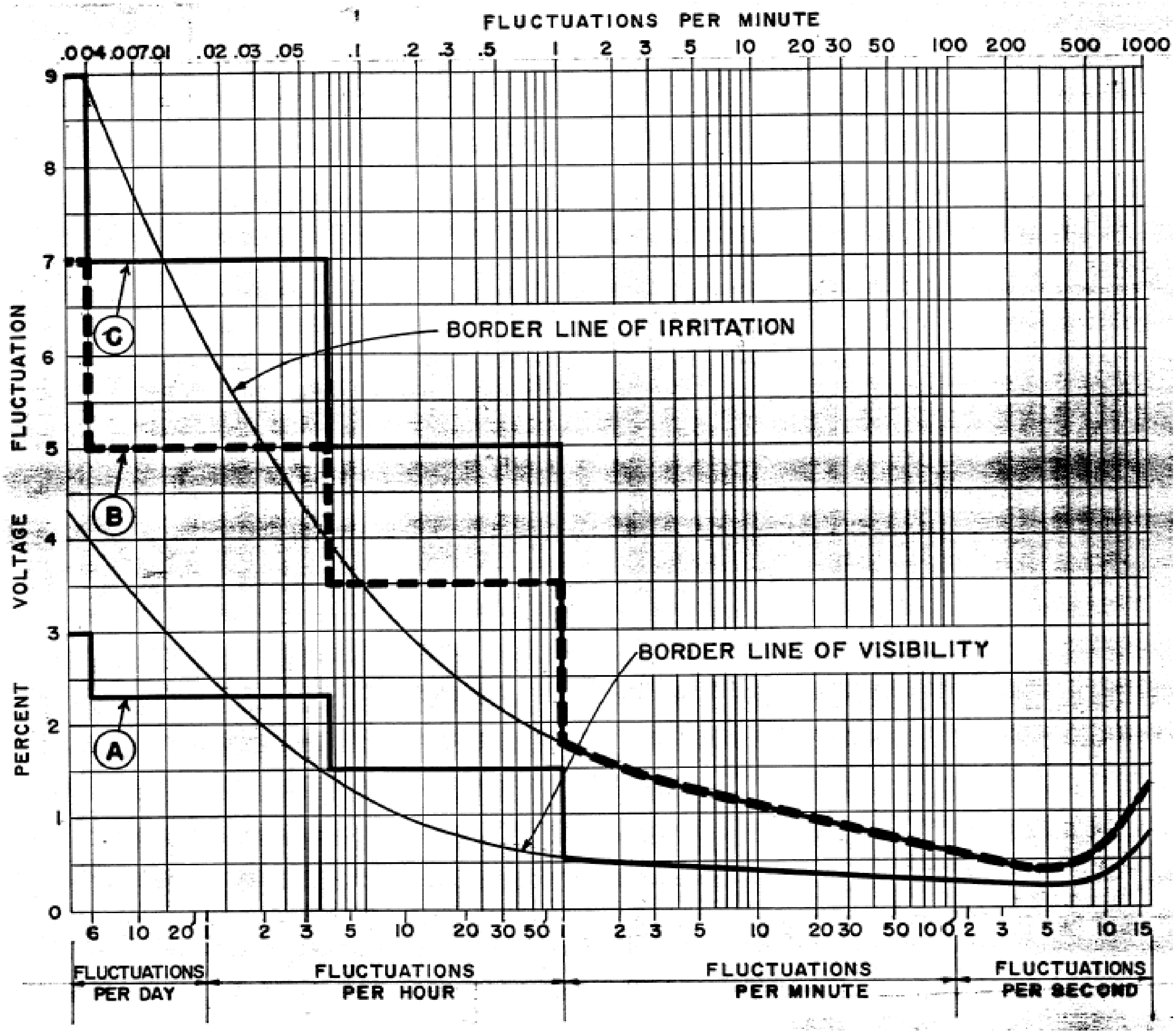


A) Use compression splice, Std. Item S26D on legs.

B) Strip covering from all leg conductors **using strip guide on Insulated splice.** Strip length is important to insure proper conductor insertion and to insure no exposed bare metal outside the splice housing.

C) Bring proper ends together, short conductor of left cable with long conductor of right cable, spiraling conductor around neutral to match lay of cable; and similarly with other two cable ends.

D) Insert skinned conductors into splice as far as barrier. No bare conductor should protrude from end of connector. Indent each splice in turn, making four crimps per side using the MD-6 or equivalent tool with W243 die, Item ID 6512709. Cover with poly cover. See Standards Section 5 – Connectors for information about covers.



Supersedes 01/06 Issue – Page shift due to general revisions.

NOTES: For motor starting loads, the maximum percent voltage fluctuation allowable for each starting step shall be limited as follows:

a) On LVAC secondary network, at the service entrance equipment, or on the general system at the substation bus, *Curve A.*
b) On a primary feeder or secondary which can affect other customers, *Curve B.*
c) At service entrance on the radial service of the motor user, no limitations, but recommend voltage fluctuation not exceed, *Curve C.*

If the calculated fluctuation due to motor starting exceeds the above limitations the problem should be referred to the Engineering department. For other type of fluctuating loads, refer problem to the Engineering department.

Supersedes 01/06 Issue – Page shift due to general revisions.

INDIVIDUAL TRANSFORMER RATING IN KVA	SINGLE PHASE LOAD IN kVA TO GIVE 1% REGULATION AT VARIOUS POWER FACTORS							THREE PHASE TRANSFORMER BANK RATING IN kVA	THREE PHASE LOAD IN kVA TO GIVE 1% REGULATION AT VARIOUS POWER FACTORS						
	100	95	90	85	80	60	35		100	95	90	85	80	60	35
								NEW TRANSFORMERS (AFTER 1975)							
10	6.1	5.7	5.7	5.8	5.9	6.7	8.5	30.0	18.4	17.2	17.1	17.4	17.8	20.1	25.4
15	10.0	8.1	7.7	7.5	7.4	7.5	8.3	45.0	30.0	24.2	23.1	22.5	22.2	22.5	24.8
25	17.9	14.5	13.8	13.5	13.4	13.5	14.9	75.0	53.6	43.6	41.4	40.5	40.1	40.5	44.6
37.5	30.5	23.3	21.8	20.6	20.5	20.0	21.2	112.5	91.5	69.9	65.4	61.8	61.5	59.8	63.6
50	41.7	31.3	29.1	27.9	27.2	26.3	27.8	150.0	125	93.8	87.2	83.8	81.5	79.0	83.3
75	67.0	44.8	43.6	41.2	39.9	37.8	38.9	225.0	201	134	131	124	120	113	117
100	100	74	67	64	62	59	61	300.0	300	221	201	192	185	177	182
167	167	113	103	97	94	88	90	501.0	501	339	309	291	281	265	271
								TRANSFORMERS (1960 THRU 1975)							
5	2.4	2.1	2.0	2.0	2.0	2.2	2.5	15	7.2	6.2	6.1	6.1	6.0	6.5	7.5
10	7.2	6.3	6.2	6.2	6.3	6.8	8.1	30	21.5	18.9	18.5	18.5	18.8	20.4	24.3
15	10.1	10.0	9.7	9.7	9.4	10.1	12.8	45	30.2	30	29.2	29.2	28.2	30.2	38.4
25	19.2	16.0	15.2	14.8	14.8	14.8	16.2	75	57.6	47.8	45.5	44.4	44.1	44.1	48.6
37.5	34.1	26.2	24.8	24.0	23.4	23.4	25.7	112.5	102	78.7	74.5	72.9	70.2	70.2	77.1
50	45.5	34.5	32.1	30.9	29.4	29.4	31.0	150	137	103	96.2	92.6	88.2	88.2	93
75	75.0	53.2	49.0	46.9	46.9	44.1	46.0	225	225	160	147	141	141	132	138
100	100	75	70	67	67	63	66	300	300	226	210	200	200	188	199
167	167	113	101	95	93	85	85	501	501	339	304	286	278	254	255
								TRANSFORMERS (PRIOR TO 1960)							
5	2.3				1.7	1.7	1.9	15	6.8				5.0	5.0	5.5
10	4.8				3.5	3.5	3.7	30	14.3				10.4	10.4	11.1
15	7.1				4.8	4.8	5.0	45	21.4				14.5	14.5	15.0
25	14.3				8.3	8.1	8.3	75	42.9				25.0	24.2	25.0
37.5	23.4				12.5	11.4	11.4	112.5	70.2				37.5	34.2	34.2
50	34.5				17.2	15.6	15.6	150	103				51.6	46.8	46.8
75	53.6				22.7	20.3	19.7	225	161				68.1	60.9	59.1
100	74				31	27	26	300	222				94	81	79

The values for 60% and 35% P.F. are intended principally for use in motor starting problems. The 60% power factor is applicable to low starting current, high starting torque motors while the 35% power factor is applicable to high starting current, normal starting torque motors.

10.6 RESIDENTIAL TRANSFORMER LOADING

The following loading schedules should be used as a guide for determining when to change a transformer and what size new transformer to install for residential load only. Peak month kWh data from GIS serves as a measurement of existing load. The table shown on Page 10-11 serves for estimating new customer's expected peak month kWh load.

The need for change outs due to new loads on existing transformers can be determined by kWh data and expected kWh loads. If the total of the two exceeds changeout loading criterion, a transformer change is warranted. If it exceeds the maximum install loading but not the changeout loading, change of the transformer should be avoided unless significant load growth or voltage problems are anticipated.

If the existing peak month kWh loads from GIS exceed transformer peak month changeout loading, change transformer and size as shown below.

New transformer installations should be sized in accordance with the install loading table, with consideration for adjacent building lots if development is anticipated within 3 years. Refer to Electrical Service Information and Requirements Handbook and local city/town ordinances for information on and mandates to locate certain residential electric facilities underground.

Engineers and planners must exercise good judgment in selecting transformers, taking probable load growth, economy, and performance into consideration.

	SUMMER CRITICAL		WINTER CRITICAL	
Transformer Nameplate	**Changeout Loading (Peak Month kWh)**	**Install Loading (Peak Month Kwh)**	**Changeout Loading (Peak Month kWh)**	**Install Loading (Peak Month kWh)**
5 *	1,800	001 to 1,300	2,500	001 to 1,500
10	4,100	1,300 to 3,200	5,500	1,500 to 4,000
15 *	7,300	3,200 to 5,000	9,500	4,000 to 5,000
25	13,700	5,000 to 10,500	17,000	5,000 to 12,000
37 ½ *	20,500	10,500 to 17,000	27,000	12,000 to 18,000
50	27,500	17,000 to 26,500	38,000	18,000 to 30,000
75	41,000	26,500 to 35,000	60,000	30,000 to 39,000
100	55,000	35,000 to 53,000	82,000	39,000 to 70,000
167	92,000	53,000 to 83,000	140,000	70,000 to 110,000

* No longer PPL standard transformer kVA sizes

The schedule for summer critical loading of pole mounted transformers is based on an expected 5% annual load growth and approximately 160% peak one-half hour demand at changeout.

The schedule for winter critical pole mounted transformer loading is based on an expected 5% annual load growth and approximately 200% peak one-half hour demand at changeout.

If a transformer is suspected of supplying appreciable air conditioning load, the 160% summer loading design criteria does not apply and field testing should be utilized.

Supersedes 7/09 issue – New page. Added residential transformer loading information and table.

When new residential customers are to be serviced and no kWh data is available the following figures may be used as expected peak month kWh consumption to add to other known kWh load for determining required transformer capacity.

Connected Load	Expected Load (Peak Month kWh)		
	Single Family	**Multifamily Family Dwelling Units**	**Mobile Homes Permanent Residence**
Less than 800 square feet, no heat		600 *	
More than 800 square feet, no heat		800 *	
No heat	900 *		800 *
Up to 5 kW heat	2800	1600	2500
Up to 10 kW heat	4300	2500	3500
Up to 15 kW heat	5800	3500	4500
Up to 20 kW heat	6300	4200	
Up to 25 kW heat	6800	4800	
Up to 30 kW heat	7300		
Up to 35 kW heat	7800		

Where connected load includes range, water heater and/or dryer, add applicable kWh shown below to the living unit expected load (Peak Month kWh).

Where connected load includes air conditioning, add applicable kWh to only those living units that do not have heat (e.g. living units designated *).

add:
100 kWh for Range
100 kWh for Dryer
400 kWh for Water Heater
<u>* Air conditioning</u>
600 kWh for 1-ton Window Unit
2000 kWh for 5-ton Central

To determine transformer size for overhead pole mounted transformers having connected load of both electric heat and air conditioning, the summer and winter peaks must be evaluated separately. The transformer Peak Month Kwh for each condition must be applied to respective load schedule (Summer Critical & Winter Critical) to determine which loading schedule is applicable.

Distributed Generation (DG) Loading Requirement

A DG system is designed to produce electrical energy. A comprehensive understanding of its impact to residential loading must be considered. Photovoltaic (PV) is typical type of generation which includes panels which themselves cannot be "turned off". As long as sun is shinning on the modules, DC current can flow to concentrators or combiner boxes, and/or inverters. Therefore, it is very important to identify it's impacts on residential transformer loading.

Supersedes 7/10 issue – Added DG Loading requirements.

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CU = PR1STS	Sec. Clamp
CU = PR1SSA	Sec. Clamp Angle
CU = PR1SSA2	Sec. DE Angle 61°-90°

Supersedes 7/10 Issue – Added Fig. 2A and updated drawings to 3-D.

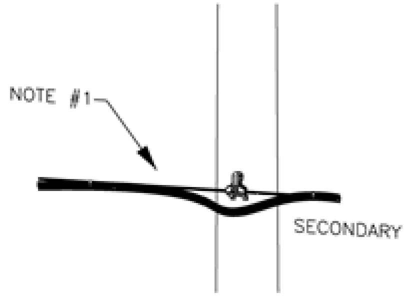


FIG. 1 – STRAIGHT LINE POLE

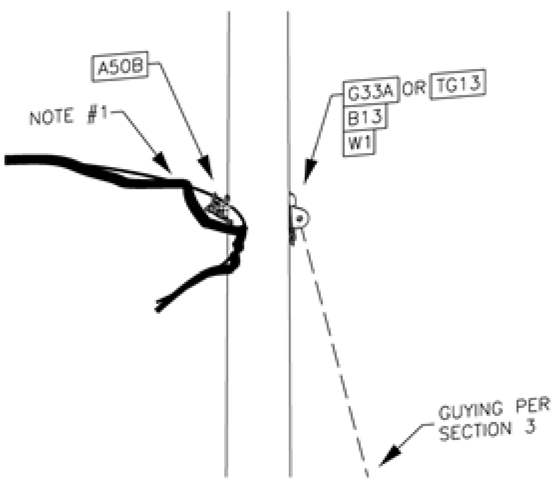


FIG. 2 – ANGLE POLE
1°–10° LINE ANGLE

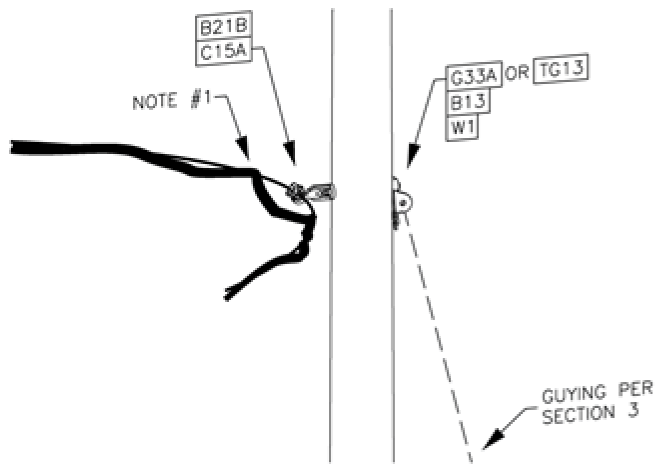


FIG. 2A – ANGLE POLE
11°–60° LINE ANGLE

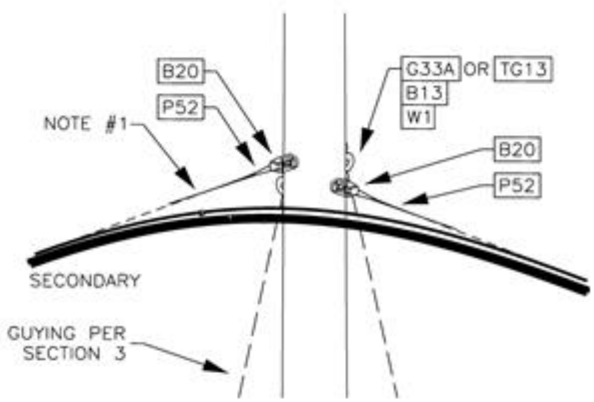


FIG. 3 – CORNER POLE
61° & GREATER LINE ANGLE

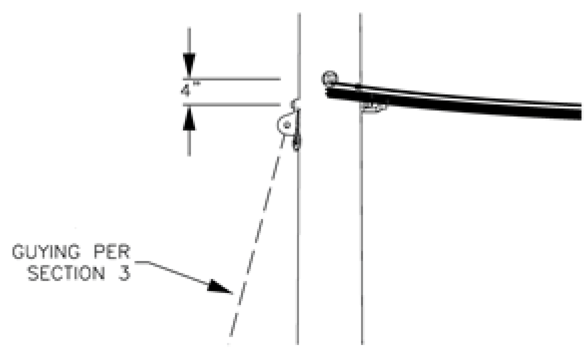


FIG. 3A – ELEVATION
SHOWING BOLT SEPERATION

NOTE:
1. TRAIN CABLES NEATLY AND KEEP APPROXIMATELY 2" AWAY FROM POLE.

CU = PR1STAP	Deadend Sec. Tap
CU = PR1SSADE	Deadend Sec.

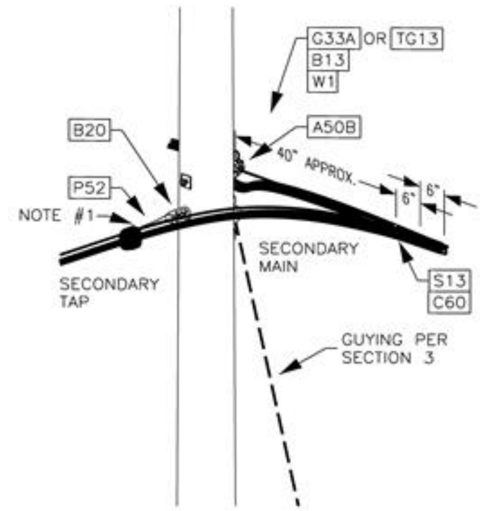


FIG. 4 – JUNCTION POLE

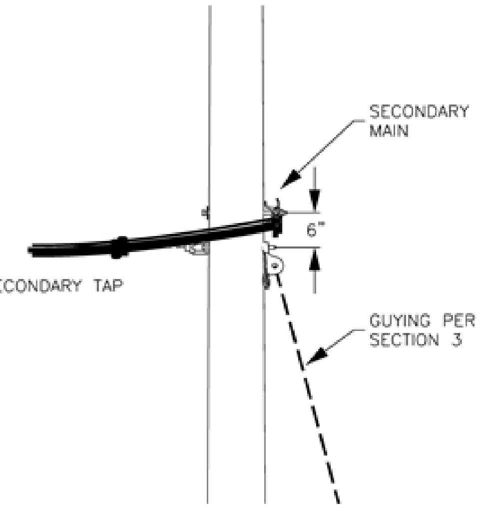


FIG. 4 – SIDE VIEW

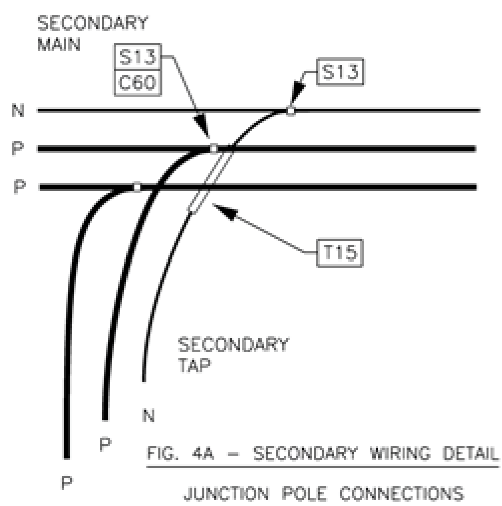


FIG. 4A – SECONDARY WIRING DETAIL

JUNCTION POLE CONNECTIONS

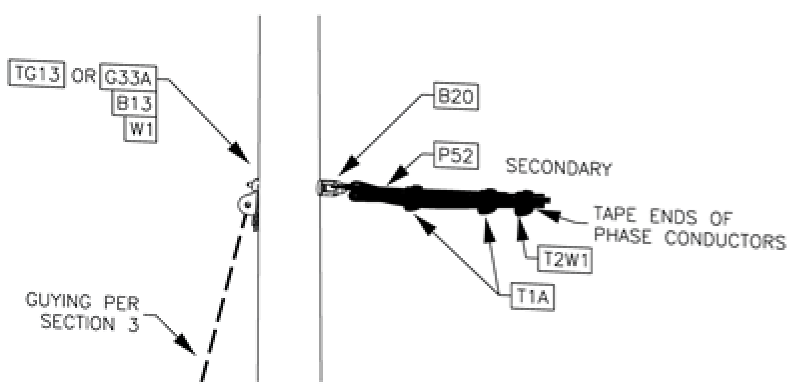


FIG. 5 – DEAD END POLE

Supersedes 7/10 Issue – Updated Drawings to 3-D.

CU = CNCUT	Sec. Crib Cut/Splice	PR1STS	Sec. Clamp 0° - 60°
CU = PR3SS	3-Spool Sec. Rack	PR1STRAP	Sec. Tap Triplex Bolteye
CU = CCTPS	Reconnect Sec. Taps		

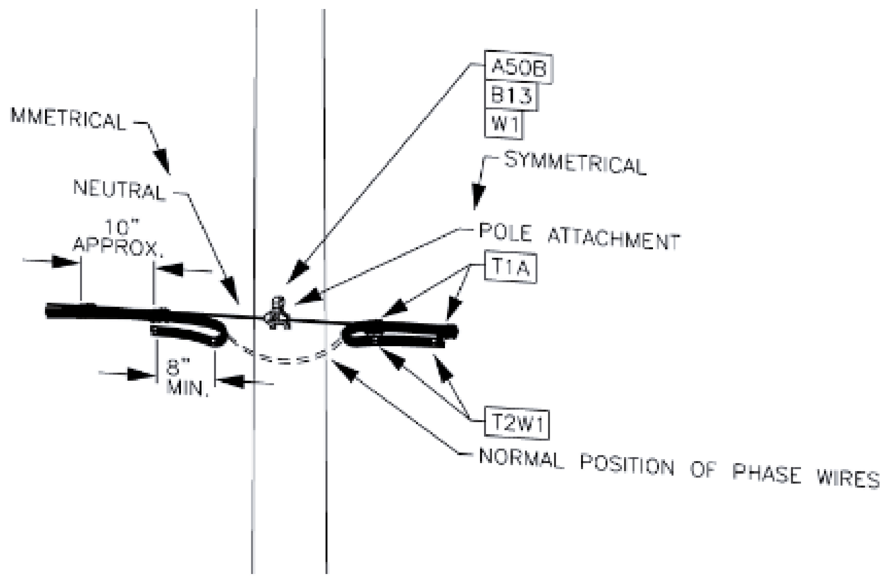


FIG. 6 – TIE POINT

PROCEED AS FOLLOWS:
1. TAPE TRIPLEX CABLE IN PLACE AT TWO POINTS EACH SIDE OF POLE BEFORE CUTTING PHASE CABLE.
2. CUT PHASE CABLES AT EACH SIDE OF POLE.
3. TAPE ENDS AND BEND BACK APPROXIMATELY TO POSITION SHOWN.

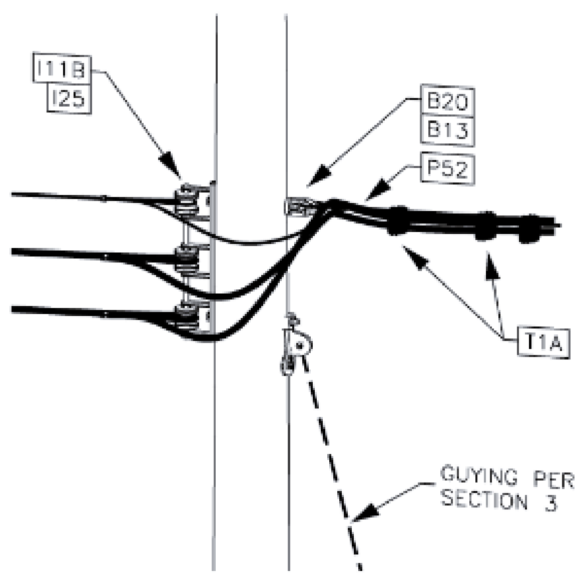
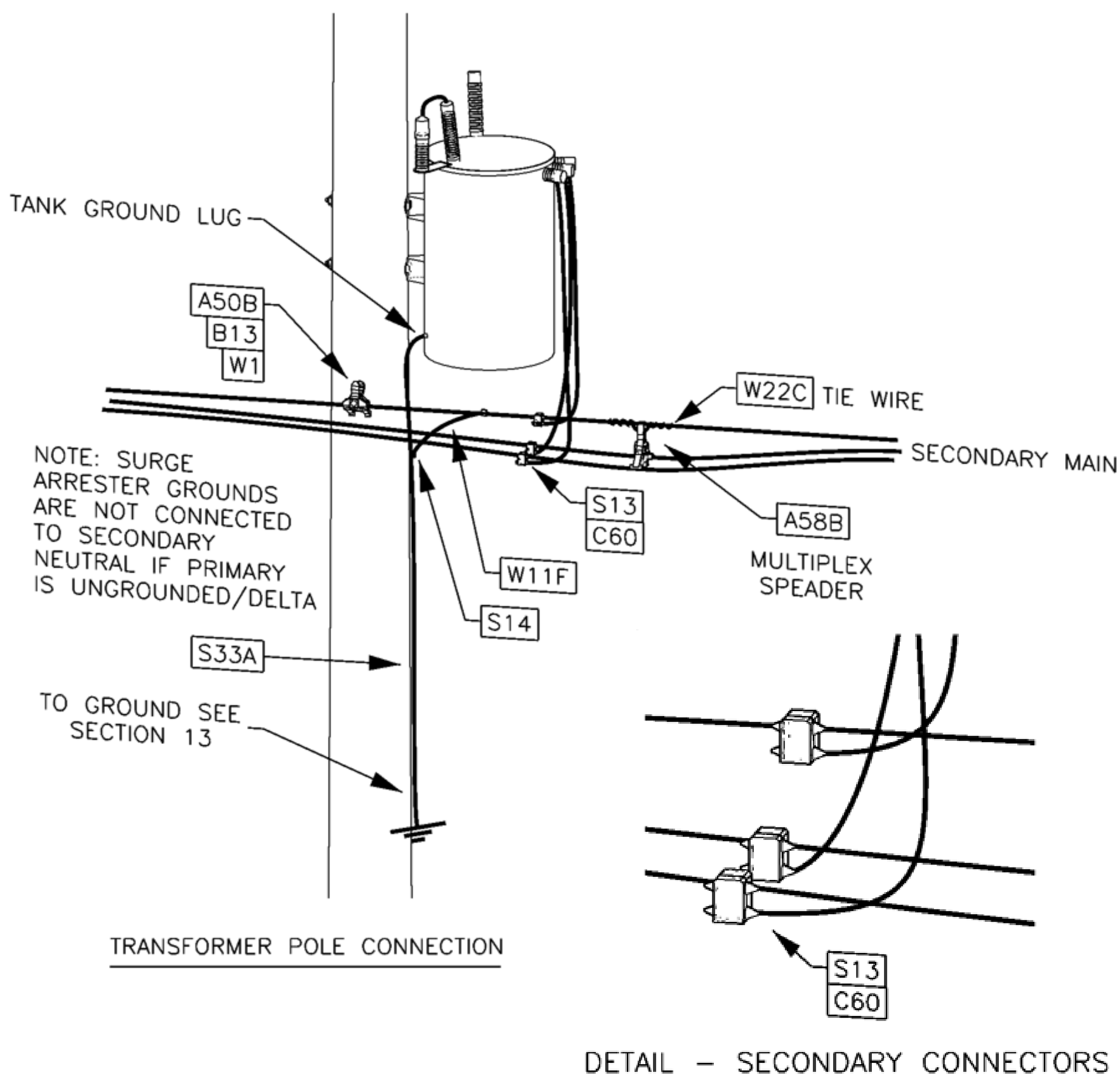


FIG. 7 – CONNECTION TO OPEN WIRE

VERTICAL RACK ILLUSTRATED

Supersedes 7/09 Issue – Updated drawings to 3-D.

CU = CSTQS	Sec. Multiplex Spacer



NOTE:
1. FOR ELECTRICAL WIRING DIAGRAMS SEE TRANSFORMERS SECTION 14 DRAWINGS.
2. COPPER TAP CONDUCTOR SHALL BE PLACED IN CONNECTOR BOTTOM POSITION.

Figure 8 – Transformer Pole Connection

Supersedes 7/17 Issue – Cleared up blurry drawing.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
7	7/20	• Added verbiage on 10-11		
6	7/18	• Cleared up blurry drawing on page 10-103.		
5	7/17	• Added Figure 2a on page 10-100. • Updated drawings to 3-D on pages 10-100 through 10-103.		
4	7/16	• Revised 10.0.30(D) and 10.0.70 to eliminate taping connectors option. • Corrected paragraph numbering of 10.0.60 through 10.0.90.		
3	7/12	• Added paragraph 10.0.70 – Secondary Cable Dimensions		
2	7/10	• Updated Std Item #s on Drawings 10-100 and 10-101. • Added side view of Figure 4 on Drawing 10-101 to show elevation difference between two bolts. • Added Section 10.6		
1	07/09	• General revision of entire section. • Added CUs to drawings/figures.		

Supersedes 7/07 Issue – Added reference to new Note 6 in Table 1.

11.0 GENERAL

These standards cover overhead services of less than 600 V and only that portion of each service that is to be installed by PPL. See Section 10, Secondaries, for sizing conductors and transformers. Normally, overhead secondary services shall be offered in the following voltages:

120/240 V Single Phase - 3 wire (for load not exceeding 100 kVA)
208Y/120 Three Phase - 4 wire (for non-residential only)
480Y/277 Three Phase - 4 wire (available by special arrangement and approval only)
240 V and 480 V delta services are not available for new installations

The Service Drop or Lateral is the overhead conductor between the last pole or other aerial support on the primary line and the first point of attachment to a building. The Service Entrance is the conductor between the service drop/lateral and the service entrance switch.

The Company will attach the service drop/lateral to the Customer's structure at the service bracket (supplied by and installed by the customer). See the "**Specifications for Electric Installations**" for metering and details of the Customer's installation.

CAUTION: 18 inches of clearance should be maintained between any gas regulator vent and the socket of an electric meter.

11.1 CONDUCTORS

11.1.10 Selection of Conductors

Aluminum multiplex conductors shall be installed for all new and replacement overhead services unless otherwise noted. For new construction, conductor size selected from Table 1 below will be determined by the Customer service entrance rating. Use triplex conductors for single-phase services and quadruplex for 3-phase, 4-wire services. Aluminum service cable #2 and 1/0 triplex and 1/0 and 336.4 kcmil quadruplex shall be used in accordance with information below and the standards that follow in this section. In general, #2 triplex cable shall be used for dwellings up to and including three family where the service load could be supplied by a 15 kVA transformer. This will include all but a very few large "all electric" homes. 1/0 Triplex service cable shall be used for large residential services where #2 cable is inadequate. Cable loads should be within limits shown on Table 2 on Page 11-2. If the length of service is such that the voltage drop may exceed 1%, a larger conductor should be used.
When a customer upgraded a service, the existing service cable can stay in service unless voltage drop or flicker will affect the customer.

TABLE 1

SERVICE ENTRANCE		RECOMMENDED CONDUCTOR		
TYPE	MAX. AMPACITY	SIZE AND TYPE	STD. ITEM	ITEM ID
SINGLE PHASE	100 A.[1]	#2 TRIPLEX	W15B	4003306
	150 or 2 100 A.	#2 TRIPLEX	W15B	4003306
	200 A.[4]	1/0 TRIPLEX	W15C	4003310
	400 A.	336.4 QUADRUPLEX[2, 6]	W16E	4004436
THREE PHASE	150 A.	1/0 QUADRUPLEX	W16C	4004410
	400 A.	336.4 QUADRUPLEX	W16E	4004436
	800 A.[3]	(2) 336.4 QUADRUPLEX[2]	W16E	4004436
	800 A.	(8) #4/0 CU.[2]	W33C	4020111

Notes:
1. New single-phase service entrances shall have a capacity of not less than 100 A for a single meter or not less than 150 A for more than one meter.
2. #4/0 CU (W33C) may be substituted for 336.4 kcmil multiplex for short runs directly from transformer to service entrance.

3. See Page 11-141 for 400 A and 800 A services.
4. If loads are likely to exceed 25 kW, use 336.4 kcmil quadruplex.
5. Quadruplex cable shall be used for 240 V and 480 V delta services.
6. When using quadruplex cable for a single phase service, leave the extra phase conductor and at each end, bend the end back and tape it to itself.

TABLE 2

SIZE AND TYPE CONDUCTOR		CAPACITY IN AMPERES		
LIVE LEG	MESSENGER	SINGLE CONDUCTOR	TRIPLEX	QUADRUPLEX
#4 Solid AAC*	#4 - 7 Strand AAAC	150	130	115
#2 – 7 Strand AAC	#2 – 7 Strand AAAC or ACSR	200	175	150
1/0 – 7 Strand AAC	1/0 – Strand AAAC or ACSR	270	245	210
4/0 – 7 Strand AAC*	4/0 – 7 Strand AAAC	415	380	-
336.4 – 19 Strand AAC	4/0 – 7 Strand AAAC or ACSR	550	515	445
795 – 37 Strand AAC*	336.4 – 19 Strand AAC	935	900	825
350 – 37 Strand CU		705	-	-
500 – 37 Strand CU		890	-	-

*Nonstandard – Values are given for comparison and special installations
The above is based on 100^{0}F/37.7^{0}C ambient and 194^{0}F/90^{0}C continuous operation with 3 feet per second wind velocity – also standard cable with cross-linked polyethylene insulation. The values should be reduced 20% for polyethylene insulation.

Supersedes 7/18 Issue – Revised 11.2.

11.1.20 Sag

Sag service wire to the values shown on Page 11-61. It is often necessary to make some variations in sags to balance loads on service wires. Good judgment shall be used when making such variations.

11.2 CONNECTIONS TO SECONDARIES

Taps from multiplex secondaries should be located approximately 3 feet from the pole as shown on Page 11-115 (to minimize pole congestion). Taps may also be made elsewhere in the span if there are right-of-way or clearance problems. Balance the service wire tension at each tap when practicable.

See Section 5, Connectors, for service/secondary connectors and splices.

See Section 48 (Underground – Risers)) for connection to underground service laterals. Use compression type connectors for service connections whenever possible. Cover connections on covered conductors.

11.3 CONNECTIONS AT BUILDINGS

See 11-121 for multiplex service attachments at the building.

11.4 CLEARANCE FROM GROUND, SWIMMING POOLS, AND STRUCTURES

Adequate clearances shall be maintained. See Section 7 and the "**Specifications for Electric Installations**". Where it is necessary, an intermediate pole or a riser on the building shall be installed. Reference should be made to the above handbooks for a division of cost for such supports, or for long service drops/laterals on private property. Adjacent buildings not on property being served shall not be used to support service wire.

Services should not be installed over swimming pools or surrounding areas extending 25 feet horizontally from the pool edge. If crossing cannot be avoided, see Section 7 for clearance.

11.5 SURGE ARRESTERS

Surge arresters shall not be installed on services. Where customers desire protection against induced lightning surges, they may install an arrester in the service entrance box on the load side of the meter.

11.6 GUYING

It is recommended that guys be installed on poles with heavy unbalanced services, particularly when all services are taken off from the same side of a line of poles.

11.7 GROUNDING AND BONDING

The messenger of multiplex cables shall be connected to the grounded secondary neutral at the pole. It shall also be connected to the Customer's neutral for 120/240 V, 120/208 V, or other grounded neutral service. The messenger shall be bonded to the metal mast or riser at the building.

One of the three insulated conductors of a 240 V delta service may be grounded at the pole and at the service entrance box.

11.8 TYPICAL 100 AMPERE OVERHEAD TEMPORARY SERVICE STRUCTURE WHERE SERVICE DROP DOES NOT CROSS OVER A HIGHWAY

11.8.10 Application

The following are details for a 100 A, 120/240 V, single phase overhead temporary service. Temporary service is considered a service that will generally be in use for less that one year. Use of this installation as a permanent service basis shall not be permitted. Additional clearances per latest National Electrical Safety Code (NESC) must be incorporated with this design should a communication company attach to this structure.

11.8.20 Division of Responsibility (See Page 11-151)

Location of temporary service shall be specified by the Company.
The CUSTOMER and CONTRACTOR shall:

A. Furnish, install, maintain, and remove:
   1. Wood structure, braces, and stakes as shown.
   2. Weatherproof meter socket and disconnect including waterproof entrance fittings.
   3. GFCI protected polarized receptacles.
   4. SE cable, staples and weatherhead
   5. Ground rods, ground conductor, ground molding, staples and ground rod connector.
   6. Obtain inspection and approval from local wire inspector.

The Company shall:

A. Furnish, install, maintain and remove:
   1. Overhead service drop from pole to temporary service structure.
   2. Overhead service drop connectors and attaching hardware.
   3. Secondary meter.

11.8.30 <u>Notes</u>

A. Where it is necessary to cross a roadway or highway with the overhead service drop conductors, distribution line construction as specified by the Company shall be used.

B. Service drop conductors shall meet all overhead clearance requirements of the latest issue of the NESC.

C. Service drop conductors shall be installed in accordance with sag/tension tables within these construction standards.

D. All post, brace, and stake wood members shall be "nominal", and those routinely available from lumber yard stock. Pressure treated lumber is recommended.

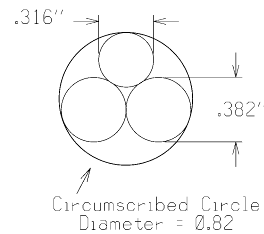
E. The customer, or the customer's contractor, shall meet all clearances and construction requirements set forth in the latest edition of the National Electrical Code (NEC) and as required by local authorities and the local Wire Inspector.

		INITIAL SAG (INCHES)			
	SPAN (FEET)	#2 AAC TRIPLEX (W15B)	1/0 AAC TRIPLEX (W15C)	1/0 AAC QUADRUPLEX (W16C)	336.4 AAC QUADRUPLEX (W16E)
TEMP. OF 32⁰F	50	3	8	9	14
	60	6	12	14	20
	70	10	18	19	27
	80	15	24	26	34
	90	21	31	34	43
	100	27	39	42	53
	110	34	47	52	64
	120	43	57	62	76
TEMP. OF 60⁰F	50	5	10	11	16
	60	8	15	16	22
	70	13	20	22	28
	80	18	26	28	36
	90	24	33	36	45
	100	30	41	44	55
	110	37	50	54	66
	120	45	59	64	78
TEMP. OF 90⁰F	50	7	12	13	17
	60	11	17	18	23
	70	16	22	24	30
	80	21	28	30	38
	90	27	35	38	47
	100	33	43	46	57
	110	40	52	60	68
	120	49	62	66	80

		FINAL SAG (INCHES) @MAXIMUM DESIGN TENSION			
	SPAN (FEET)	#2 AAC TRIPLEX (W15B) 650 LBS	1/0 AAC TRIPLEX (W15C) 650 LBS	1/0 AAC QUADRUPLEX (W16C) 680 LBS	336.4 AAC QUADRUPLEX (W16E) 1,000 LBS
TEMP. OF 90⁰F	50	10	14	14	18
	60	14	19	19	24
	70	19	24	25	31
	80	24	30	32	39
	90	30	37	40	48
	100	36	45	48	58
	110	43	54	58	69
	120	52	64	68	81

#2 AWG Triplex Service Cable – "SHRIMP/XLP" (W15B)

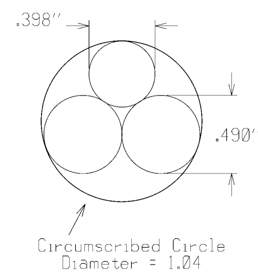
One - #2 AWG, 6201-T81, 7 strand AAAC Messenger Diameter = .316 inches
Two - #2 AWG, 1350-H19, 7 strand AAC Phase Conductor Diameter
with 45 mils of XLP = .382 inches



LOADING	
DEADEND	650 LBS
TRANSVERSE	.590 LBS./FT.
VERTICAL	1.04 LBS./FT.
TOTAL	1.496 LBS./FT.
SWING ANGLE	57.0^0

1/0 AWG Triplex Service Cable – "GAMMARUS/XLP" (W15C)

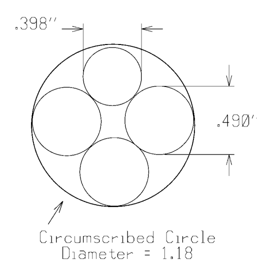
One - 1/0 AWG, 6201-T81, 7 strand AAAC Messenger Diameter = .398 inches
Two - 1/0 AWG, 1350-H19, 7 strand AAC Phase Conductor Diameter
with 60 mils of XLP = .490 inches



LOADING	
DEADEND	650 LBS
TRANSVERSE	.666 LBS./FT.
VERTICAL	1.318 LBS./FT.
TOTAL	1.774 LBS./FT.
SWING ANGLE	51.0^0

1/0 AWG, Quadruplex Service Cable – "SHETLAND/XLP" (W16C)

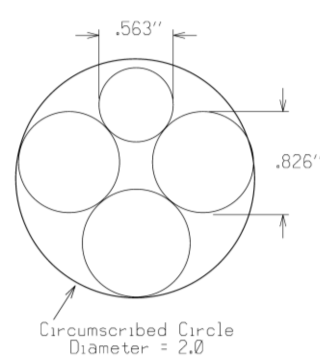
One - 1/0 AWG, 6201-T81, AAAC Messenger Diameter = .398 inches
Three - 1/0 AWG, 1350-H19, AAC Phase Conductor Diameter
with 60 mils of XLP = .490 inches



LOADING	
DEADEND	680 LBS
TRANSVERSE	.707 LBS./FT.
VERTICAL	1.568 LBS./FT.
TOTAL	2.020 LBS./FT.
SWING ANGLE	45.0^0

336.4 KCMIL Quadruplex Service Cable – "EXMOOR/XLP" (W16E)

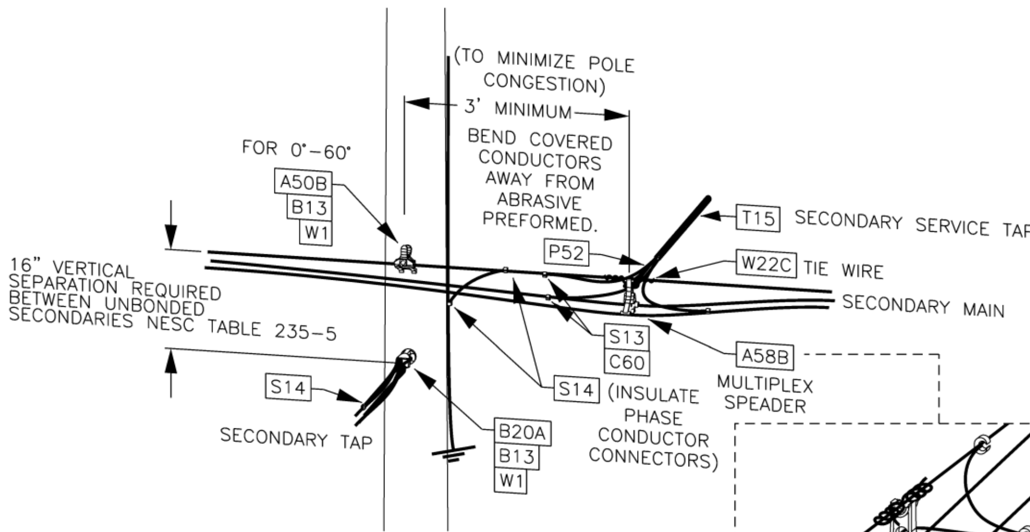
One - 4/0 AWG, 6201-T81, 7 strand AAAC Messenger Diameter = .563 inches
Three – 336.4 KCMIL, 1350-H19, 19 strand AAC Phase Conductor Diameter
with 80 mils of XLP = .826 inches

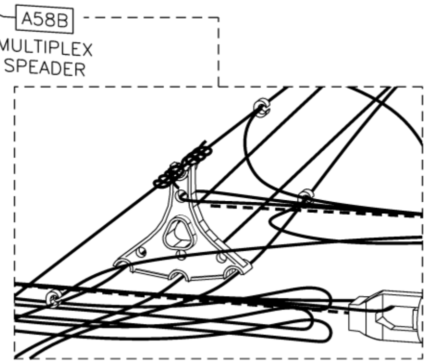


LOADING	
DEADEND	1,000 LBS
TRANSVERSE	.973 LBS./FT.
VERTICAL	3.00 LBS./FT.
TOTAL	3.452 LBS./FT.
SWING ANGLE	32.5^0

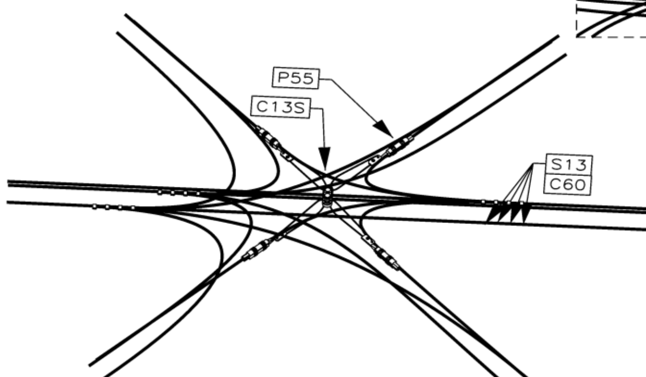
Supersedes 01/06 Issue – Revised circumscribed circle dimensions.

Supersedes 7/17 – Updated Note 8.





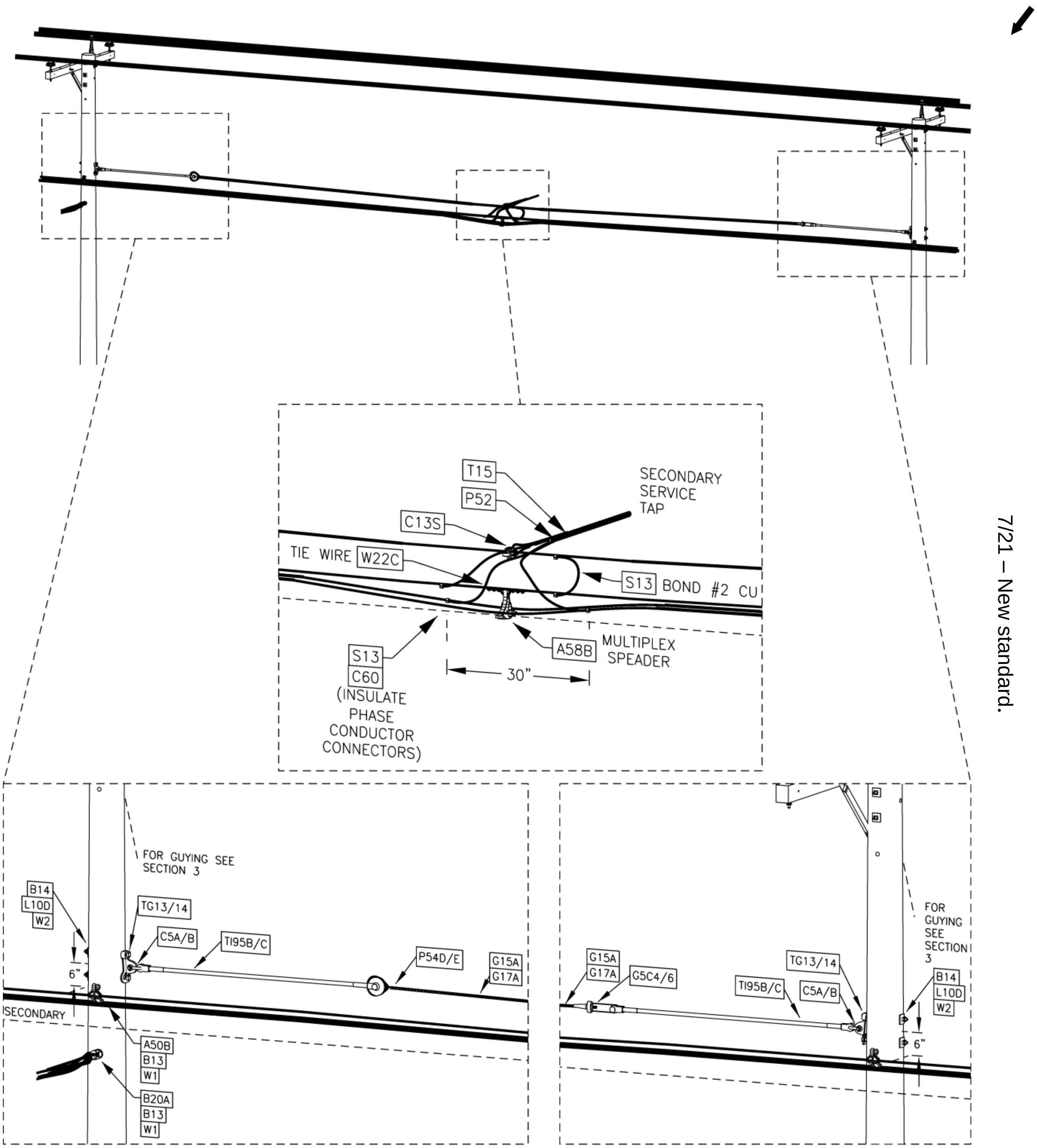
TYPICAL MULTIPLEX MIDSPAN TAP



FOR A SINGLE OR MULTIPLE MIDSPAN SERVICE TAP
FROM PARALLEL LAY SECONDARY OR FROM A POLE TO POLE GUY.

NOTE:
1. MULTIPLEX SPREADER (A58B) IS HELD INTO PLACE BY TIE WIRE (W22C), ATTACHED THROUGH TOP SPACER HOLE AND WIRED TO THE MESSENGER.
2. SEE PAGE 11–1 FOR CONDUCTOR SIZE SELECTION.
3. SEE SECTION 5 FOR CONNECTOR DETAILS.
4. INSULATE ALL COVERED CONDUCTOR CONNECTIONS.
5. ALWAYS POSITION COPPER CONDUCTORS BELOW ALUMINUM IN CONNECTORS.
6. REFER TP PAGE 11.2 FOR NOTES ON LOCATION AND BALANCING OF TAPS.
7. SEE GUYING STATEMENT ON PAGE 11–3.
8. TO AVOID EXCESSIVE SECONDARY CABLE OFFET DUE TO AN UNBALANCED MID–SPAN SERVICE, INSTALL A POLE TO POLE GUY, ATTACH THE MID–SPAN CLAMP (C13S) TO THE GUY AND BOND THE SECONDARY NEUTRAL TO THE POLE TO POLE GUY. **SEE PAGE 11–115A**

Designer	Drawing	Date
MPR	od11115	7/19/21

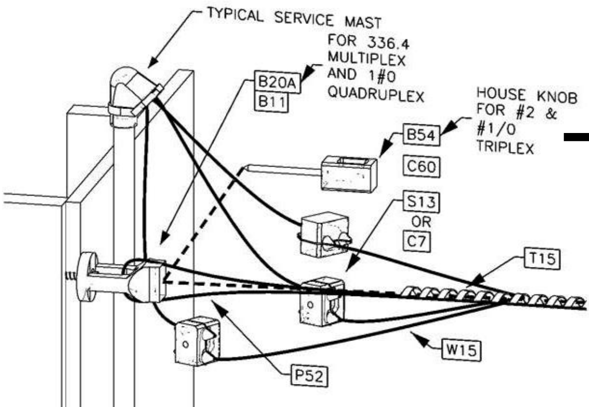


7/21 – New standard.

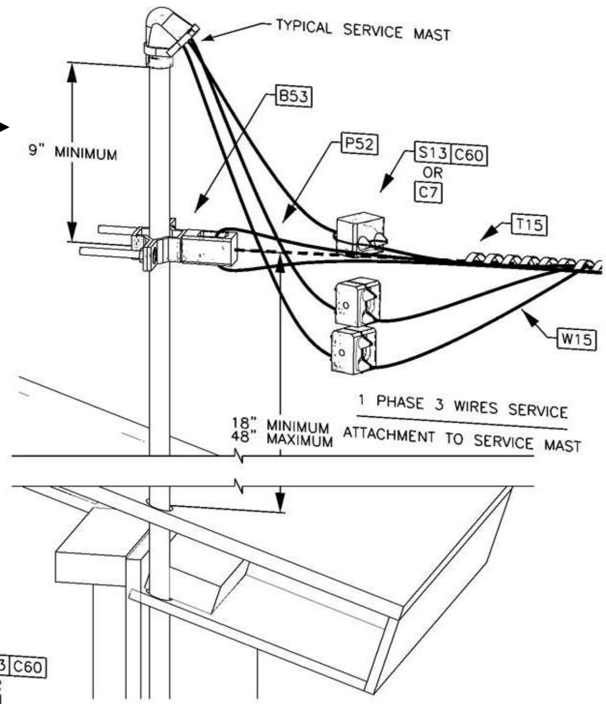
NOTE:
1. SEE DRAWING 3–115Y FOR POLE TO POLE GUY ARRANGEMENT
2. TO PREVENT UNDUE STRAIN ON THE ELECTRICAL CONNECTORS, THE SECONDARY SERVICE SIDE TAP SHALL BE PHYSICALLY ATTACHED AT BOTH ENDS BEFORE MAKING THE ELECTRICAL CONNECTIONS, INCLUDING THE BOND BETWEEN THE OVERHEAD GUY WIRE AND THE SECONDARY NEUTRAL.

Designer	Drawing	Date
MPR	od11115A	7/21/21

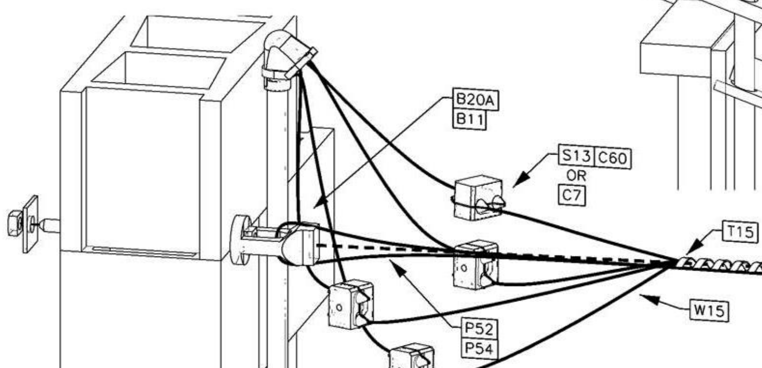
MAINTENANCE BACKYARD CONSTRUCTION ONLY



1 PHASE 3 WIRES SERVICE ATTACHMENT TO WOOD FRAME



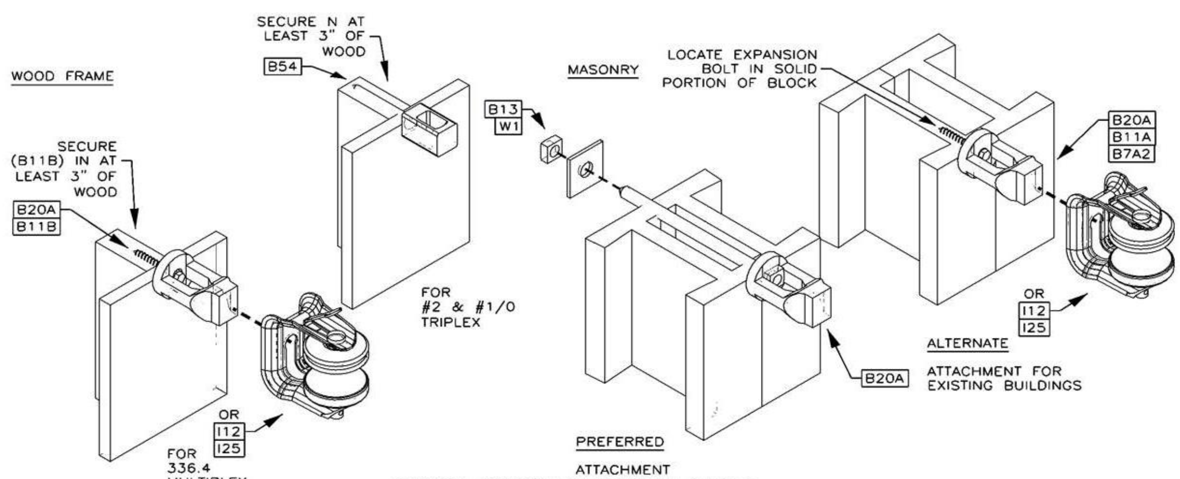
1 PHASE 3 WIRES SERVICE ATTACHMENT TO SERVICE MAST



3 PHASE 4 WIRES SERVICE ATTACHMENT TO MASONRY BUILDING

THE STRUCTURE OR RISER SHALL BE CAPABLE OF WITHSTANDING THE FOLLOWING TENSIONS

SERVICE AMPERE RATING	SERVICE CABLE SIZE	MAXIMUM TENSION
150	#2 TRIPLEX	650 LBS.
200(1ø)	#1/0 TRIPLEX	650 LBS.
200(3ø)	#1/0 QUADRUPLEX	680 LBS.
400	#336.4 TRIPLEX	1000 LBS.
600	OR QUADRUPLEX	2000 LBS.

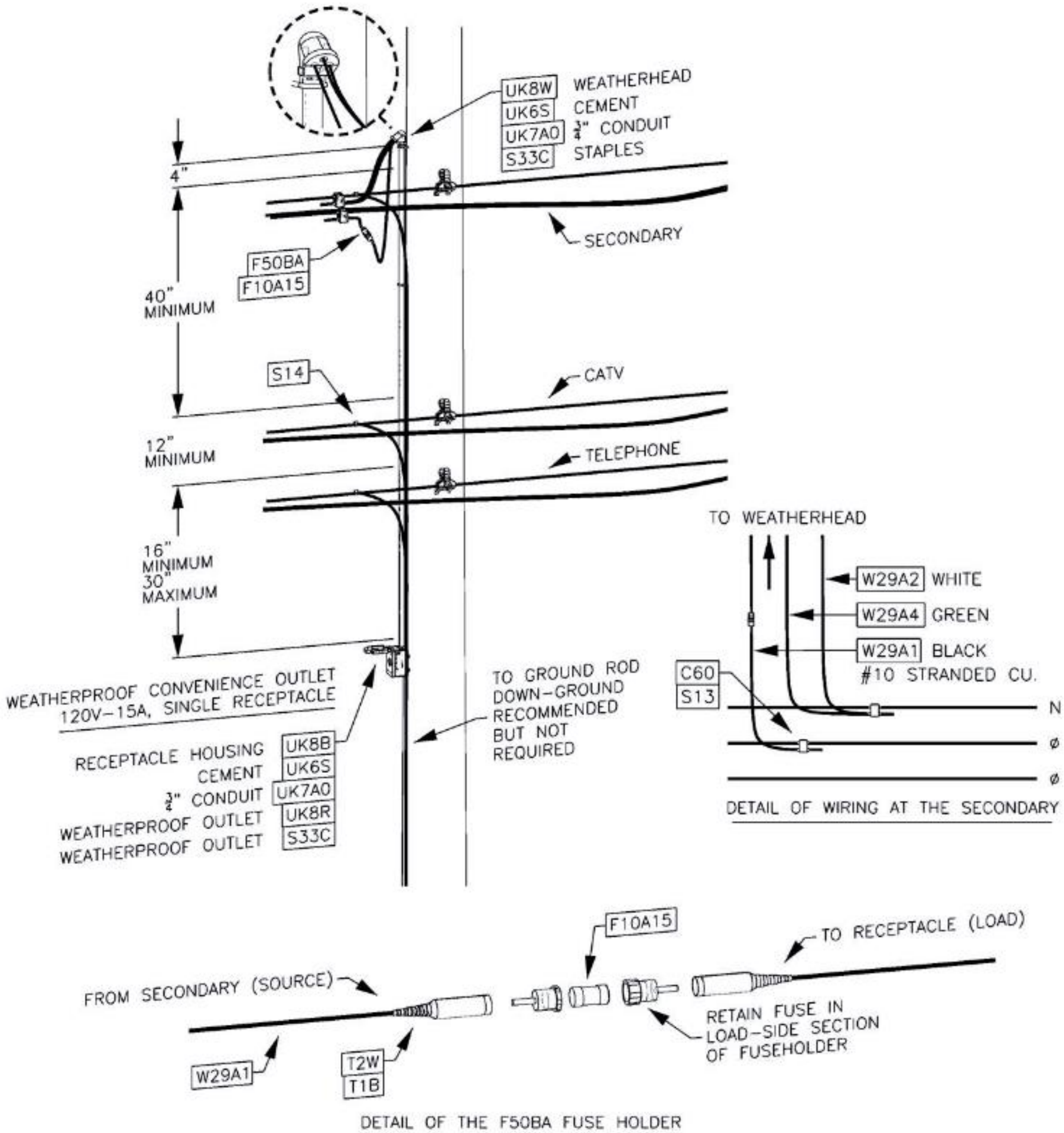


SERVICE BRACKET ATTACHMENT DETAILS

Supersedes 7/17 Issue – Updated to 3-D drawings.

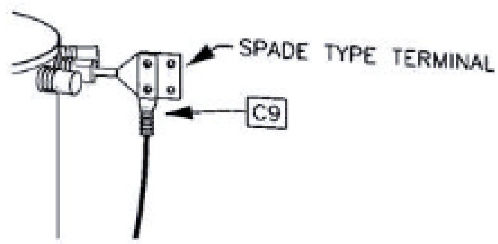
MULTIPLEX SERVICE BUILDING ATTACHMENT

ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER: 11-121	ISSUE: 7/21

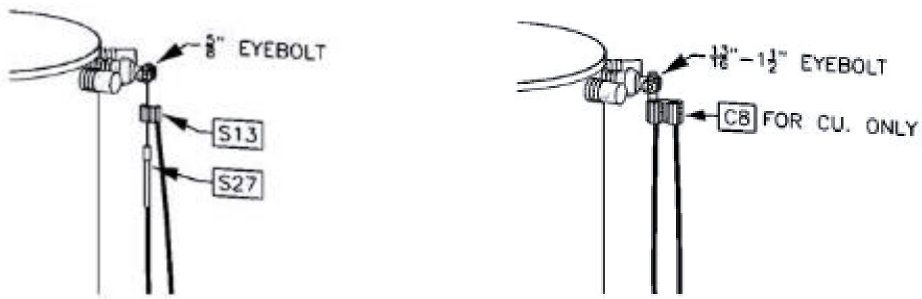


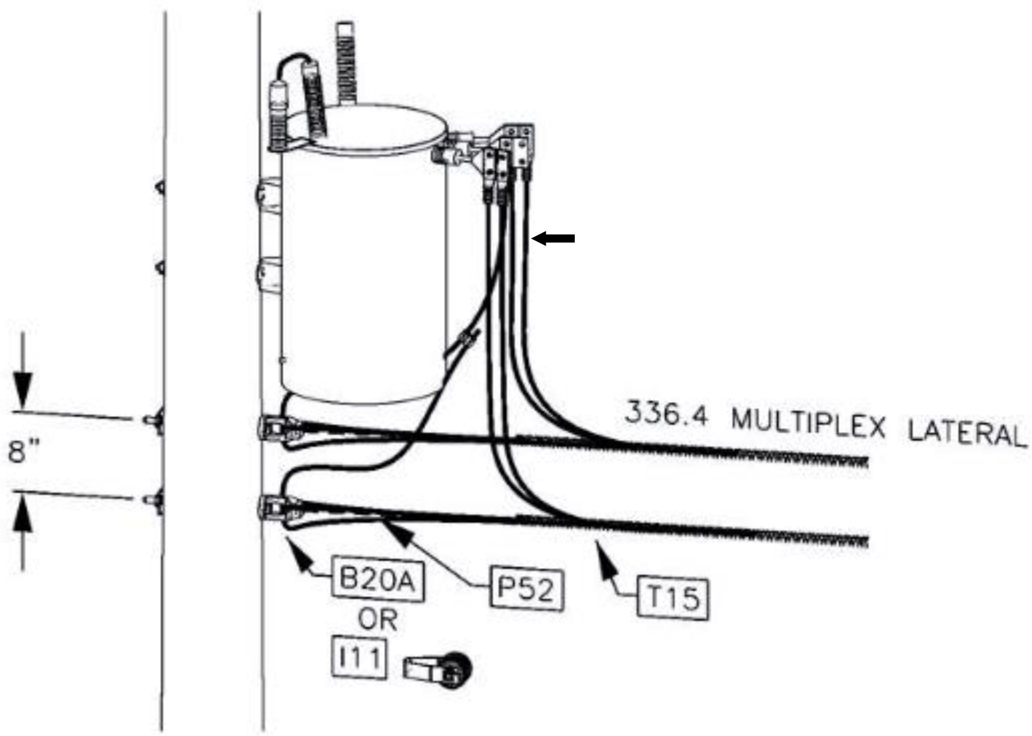
Supersedes 1/06 – Updated to 3-D drawings.

167KVA TRANSFORMERS



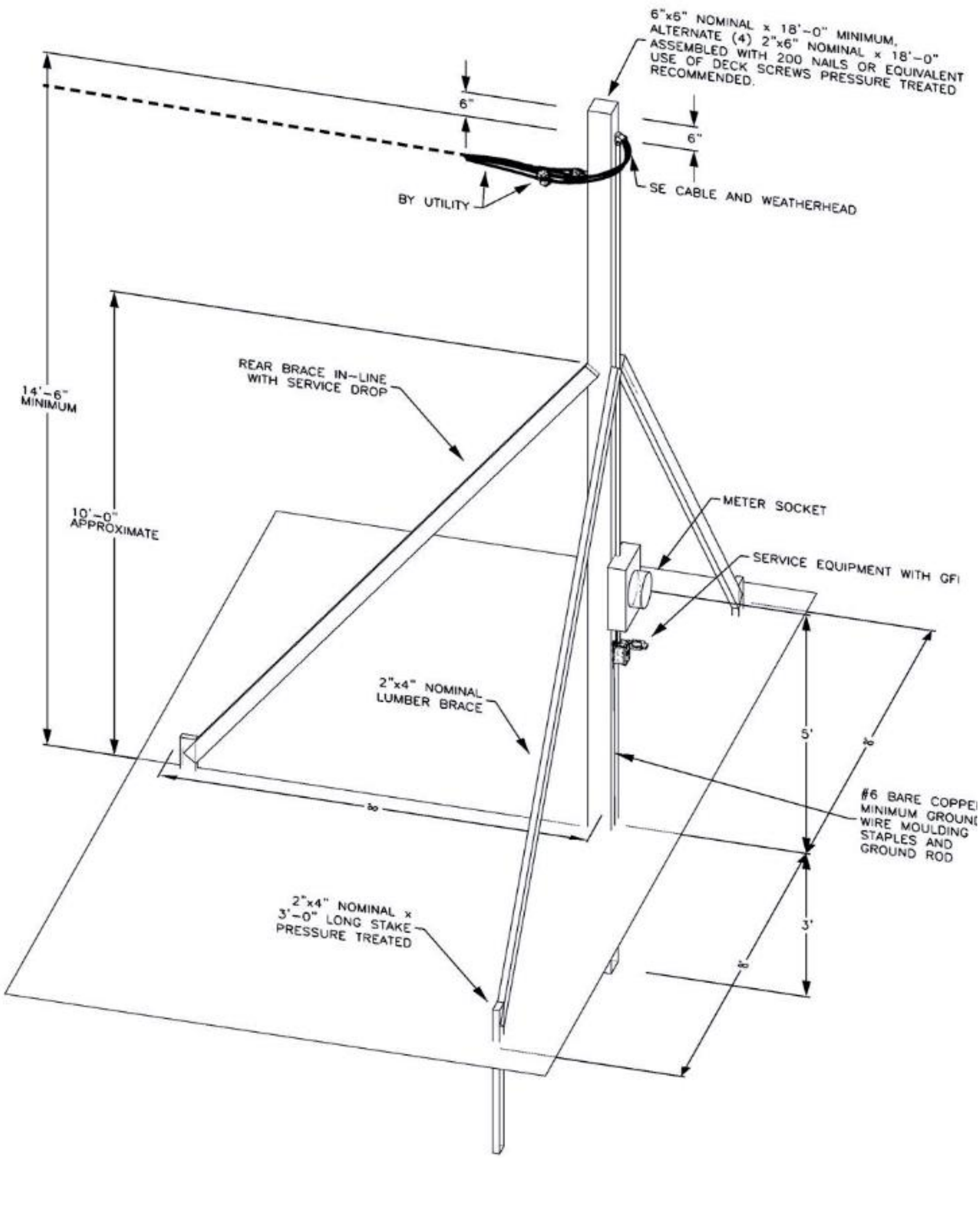
100KVA TRANSFORMERS AND BELOW





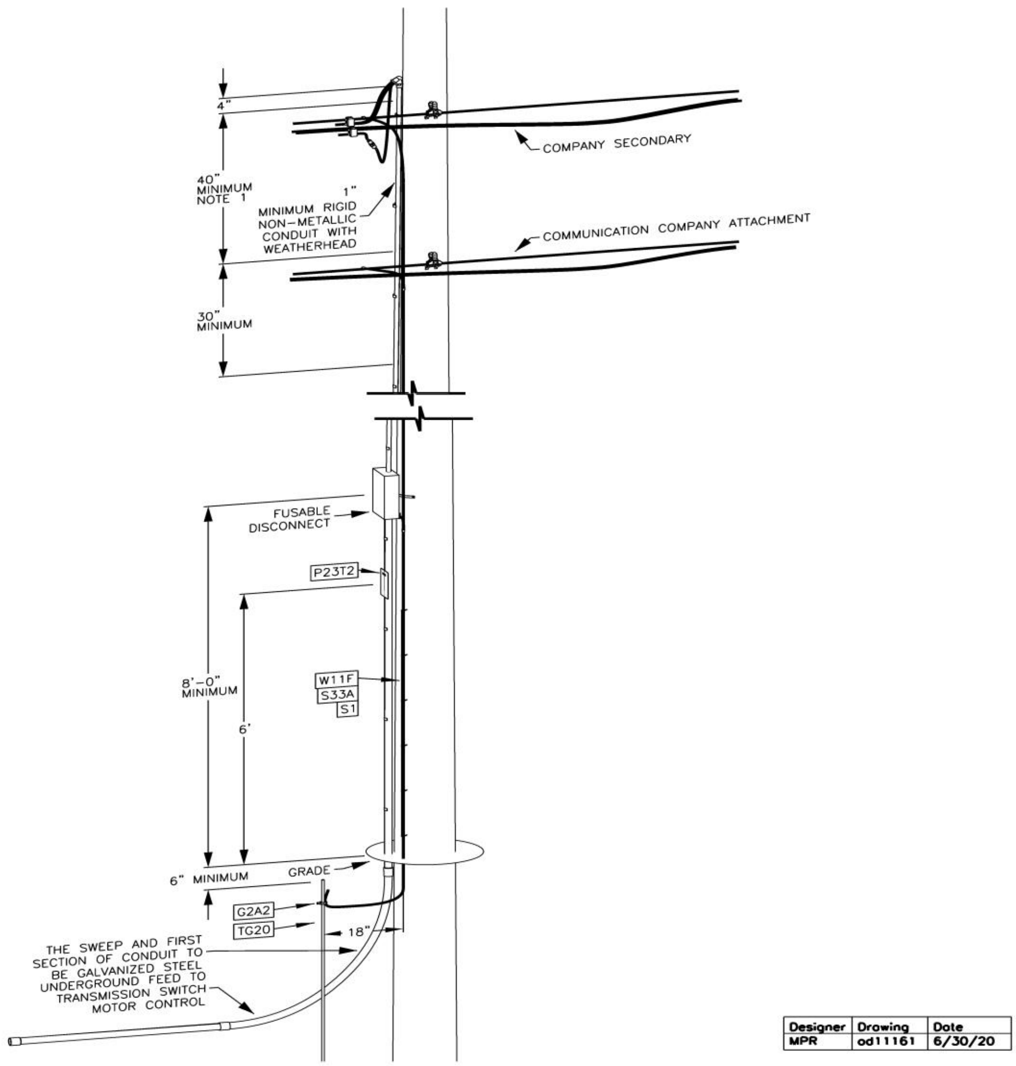
LOW VOLTAGE TERMINAL DETAILS

Supersedes 1/07 Issue – Updated to 3-D drawings.



Supersedes 1/07 – Updated to 3-D drawings.

TYPICAL 100A OVERHEAD TEMPORARY SERVICE STRUCTURE			
ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/21	11-151		



NOTES:

1. This arrangement is representative of a typical installation near a transmission structure. Additional poles and overhead construction by Distribution Line Department may be required to reach and supply riser pole
2. Environmental permitting for this type of construction is the responsibility of Transmission Line Services
3. Riser pole shall be located at the edge of the right of way near the transmission structure.
4. Underground conduit and conductors from the secondary riser to the transmission structure and connection of motor control are the responsibility of Transmission Line Services
5. Riser conduit, if metallic, shall be bonded to system neutral or a down ground
6. Fusible disconnect to be fused at 30A for a 120V service to the motor control

Version	Date	Modification	Author(s)	Approval by (Name/Title)
8	7/21	• Add new page 11-115A Midspan service tap		
7	7/20	• Add new Page 11-161 Distribution Supply to Transmission Switch Motor Control		
6	7/19	• Revised Section 11.2 (page 11-2) to eliminate deadended at the pole.		
5	7/18	• Add new Note 6 in Table 1 about the use of quadruplex cable in single phase services.		
4	7/17	• Updated drawings 11-115, 11-121, 11-122, 11-141, and 11-151 to #-D.		
3	7/16	• Revised Section 11.2 (page 11-2) and drawing 11-121 to eliminate the option of taping secondary service connectors.		
2	7/12	• Revised circumscribed circle dimensions on page 11-62.		

Supersedes Issue 7/18 – Update page numbers 12-15 through 12-21 and add page 12-146.

Supersedes 7/20 Issue – Added pages 12-352, 12-360, 12-650A/B, and 12-905A/B.

12.0 GENERAL

Short circuits, the uncontrolled flow of electricity from energized conductors or equipment to a neutral or ground, occur in power systems when insulation fails or is bypassed due to; system overvoltages caused by lightning, switching surges, insulation contamination, mechanical failures, conductive materials crossing conductors, or other natural causes. These are also referred to as “faults” and the current flow is referred to as “fault current”. The number of short circuits and the magnitude of the current flow can be minimized with proper design, operation, and maintenance of overhead distribution systems.

12.1 FUSE RATING

Type K expulsion fuse links (F1K), per ANSI C37.42, are the standard fuse links for use in enclosed and open type fuse cutouts on the Company system. K link fuses provide improved coordination with station equipment and a greater range of coordination between fuses. All of these tin element links will carry continuous current up to 1½ times their nominal rating; above 1½ times, or 150% the "Minimum Melt" threshold, melting of the fuse link will start to occur with eventual blowing of the fuse, or weakening of the fuse link causing unpredictable operation in the future. Fuse links rated up to and including 100K or 100T shall only be used in cutouts rated 100 A. Fuse links rated above 100K or 100T up to 200K or 200T shall only be used in cutouts rated 200 A.

Supersedes 7/17 Issue – Updated page references

12.1.10 Fuse Sizes For Transformers

In general, transformer installations are fused for short circuit rather than overload protection. Three-phase fusing is based on motor loads with incidental lighting, with no motor having a horsepower rating greater than 50% of the total transformer bank capacity in kVA. Special cases, such as exceptionally large motors, may require the next size primary fuse to withstand excessive current drawn during start up.

Recommended fuse sizes are shown on Page 12-17 & 12-18. In addition, CSP transformers shall be considered as conventional transformers and fused per Page 12-17 & 12-18 which may aid in increased sectionalization opportunities.

12.1.20 Fuse Sizes For Capacitors

In selecting fuse sizes for capacitors, links with adequate continuous overcurrent ratings were chosen to provide roughly, a minimum capacity of 135% of the group total and to carry excessive currents caused by overvoltage, harmonics, and inrush. Recommended fuse sizes for capacitors are given on Page 12-19.

12.1.30 Fuse Sizes For Line Coordination

Where two adjacent fuses operate in series, the “protected fuse” is on the supply side and the “protecting fuse” is on the load side. If a fault develops beyond the protecting fuse, it should clear before the protected fuse has reached 75% of its melting time. This condition can be realized only for most values of short circuit current. Large fuses with high coordinating values are used near the supply end of distribution feeders and must coordinate properly with station protective devices. Transformer fuses always are protecting fuses. Table 1 below shows coordination that can be expected between standard K link fuse sizes.

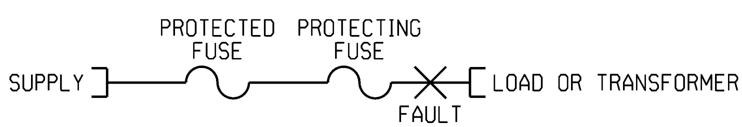


Table 1

Protecting	Protected Fuse Size					
Fuse Size	**15**	**25**	**40**	**65**	**100**	**140**
	Maximum Fault Current for Coordination					
10	430	840	1350	2200	3900	5800
15		500	1350	2200	3900	5800
20			1200	200	3900	5800
25			700	2200	3900	5800
30				1800	3900	5800
40				1300	3900	5800
50					3500	5800
65					2400	5800
80						4500
100						2000

Special fuses and fuseholders should generally be avoided. However, it may be necessary to specify them for certain applications. For example, at locations where fault current is in excess of 16,000 amperes asymmetrical, the use of standard item C47A will need to be used. If there are a number of applications, the power fuses and holders will be kept in Stores.

12.2 CONTINUOUS RATING

All devices have a continuous rating for current carrying capacity in the closed position. This rating is not to be interpreted as the disconnecting rating.

Devices used for line fuses, disconnects, and primary services shall be selected so that the anticipated load will not exceed the continuous current rating of the device. It is recommended in those areas exhibiting a past pattern of growth that the device be selected so that its initial loading will not exceed two-thirds of the continuous rating, thereby permitting a margin for growth.

12.3 DISCONNECTING RATING

The ability to disconnect load is dependent upon operating voltage, separation of contacts, power factor, atmospheric conditions, the exact instant of break point in respect to the 60 cycle wave, and other factors beyond the control of the operator.

There is no official recognition that cutouts, fused or solid blade, have the ability to disconnect load (ANSI C37.40). All cutouts and disconnects include loadbuster hooks for the use of the loadbuster tool. When the loadbuster tool is used, loads up to the continuous rating of the device, but not to exceed 600 A, may be interrupted.

Cutouts shall be selected so that they will not be required to open loads in excess of the values shown in Table 2 on Page 12-3, except cutouts for capacitor applications.

12.4 INTERRUPTING RATING

12.4.10 Cutout

The maximum fault current that a cutout can successfully perform circuit interruption is known as the interrupting rating of the cutout. It is expressed in root mean square (rms) asymmetric amperes.

Proper application of fused cutouts require selection of an interrupting rating greater than the available fault current at the given location. Interrupting ratings of cutouts are shown in Table 2 below.

The available fault current, which a fused device is required to interrupt, is dependent upon many factors including:
1. Impedance at the fault.
2. Available fault current at the substation bus.
3. Size, type, and configuration of conductor supplying the fault.
4. Distance from the substation bus.
5. Point on voltage wave at the instant of the fault,
6. Fault duration.

Short circuit analysis is used for determining available fault current values.

Table 2

CUTOUT & DISCONNECT SELECTION & RATING TABLE						
			RATINGS			
			CONTINUOUS CURRENT AMPS	INTERRUPTING RMS AMPS		DISCON. AMPS
PRIMARY CIRCUIT VOLTAGE	STANDARD ITEM #	DESCRIPTION		SYM	ASSYM	EXPERIENCE BASED
5kV CIRCUITS ONLY	C41B1 C41D1 C41D2 D1C	H.D. enclosed cutout – fused EHD enclosed cutout – fused Enclosed cutout w/ solid blade Enclosed disconnect switch	50 100 200 600	4000 8000 ------ ------	5000 10000 ------ ------	15 20 20 35
0-15kV CIRCUITS	C43S10 C43S20 C43S30 C47A D5D	Open type cutout w/ 100A fuse tube Open type cutout w/ 200A fuse tube Open type cutout w/ 300A solid blade EHD open type cutout Open disconnect switch	100 200 300 200 600	7500 8600 ------ 12500* ------	10000 12000 12000M 20000 ------	------ ------ ------ ------ ------
25&35kV CIRCUITS	C43S41	Open type cutout w/ 100A fuse tube	100	5100	8000	------

*** - Based on X/R ratio of 20** **M – Momentary Rating**

Supersedes 1/06 Issue – Table 2 C43S30 Description Change

12.4.20 Partial Range Current Limiting Fuses (CLFs)

In areas of high fault currents, an energy limiting device may be required to limit let-through short circuit current to a level that will minimize disruptive failures to transformers and other distribution equipment. High fault currents can exceed the interrupting capabilities of standard overhead protective devices (cutout fuse link or CSP internal fuse).

The add-on partial limiting CLFs (F7A), when properly matched and used in series with overhead protective devices (cutout fuse links or CSP internal fuses), will operate only at the higher fault currents ensuring a successful interruption (up to 50,000 A symmetrical).

CLFs will activate within the first 1/2 cycle during high current faults, and they will limit the overcurrent let-through to allow fuse links or internal fuses to operate concurrently.

The cutout fuse link will operate normally upon low current faults and current-limited faults. The size of the fuse link cannot be larger than the rating of the CLF, which requires proper coordination.

The CLF may become weakened by the lower magnitude faults that normally cause operation of standard fuse links. Replacing the current limiting device in conjunction with the transformer protective link may prevent a later outage that would be caused when a weakened CLF completes its internal meltdown under normal load.

CLFs shall be installed on 15, 25, and 35 kV circuits where the calculated symmetrical fault current warrants such installations.

12.4.30 Reclosers

Reclosers shall be selected so that the calculated symmetrical fault current will not exceed the nameplate interrupting rating of the recloser. Vacuum reclosers with increase fault current capabilities can be purchased for particular installations.

12.5 SELECTION GUIDE

Cutouts, CLFs, and disconnecting devices shall be selected as follows:

12.5.10 Line and Riser Cutouts

A. On all Feeders

Open-type cutouts (C43S) with loadbuster hooks shall be used as line and riser fuses where the calculated symmetrical fault current is less than 7500 A, and where it is anticipated to remain less than 7500 A for at least 5 years. For high fault current line installations, see Section 12.5.10.B.

B. In High Fault Current Areas (Above 7500 A)

Heavy-duty power-fuse cutouts (C47) shall be used on all circuits where the calculated symmetrical fault current is 7500 to 12,500 A, and where fusing above 40 A (e.g. line fuses) may be needed. On circuits where calculated symmetrical fault current exceeds 7500 A, but fusing requirements will not exceed 40 A (e.g. transformers), a standard open-type cutout (C43S) shall be used in series with a coordinated CLF (F7A).

At junction pole locations where sectionalizing is necessary, line fuses can be installed on the first pole in or at the junction pole depending upon existing clearances and construction involved.

12.5.20 Overhead Transformer Cutouts

A. Conventional Transformers

Cutouts for overhead transformers should be selected in accordance with Table 2 on Page 12-3. Transformer cutouts can be located at the tap pole for fuse coordination or bucket accessibility purposes provided they feed a single transformer.

B. Conventional Transformers in High Fault Current Areas (Above 7500 A)

New installations and conversions involving transformers thru 167 kVA on feeders where calculated symmetrical fault current exceeds 7500 A shall be equipped with a cutout (C43S) mounted in series with a coordinated CLF (F7A). Reclosers or special fuses may be required for very large banks.

C. CSP Transformers in High Fault Current Areas (Above 3500 A)
All existing installations or conversions involving CSP transformers on 15 kV feeders where calculated symmetrical fault current exceeds 3500 A shall be equipped with CLFs.

Supersedes 1/06 Issue – Removed Voltage Designations Under 12.5.10, 12.5.20. Added Cutouts At Tap Pole For Single Transformers 12.5.20A

Supersedes 7/11 Issue – changed F in 12-5.50 and added Storm Hardening criteria to 12.5.50

12.5.30 Overhead Capacitor Cutouts

A. Capacitors

Cutouts for overhead capacitors should be selected in accordance with Table 2 on Page 12-3.

B. 100 kVAR Units and Above in High Fault Current Areas (Above 5000 A)

New installations on feeders where calculated symmetrical fault current exceeds 5000 A shall be equipped with a cutout (C43S) mounted in series with a coordinated CLF (F7A).

C. 50 kVAR Units and Below in High Fault Current Areas (Above 4000 A)

New installations on feeders where calculated symmetrical fault current exceeds 4000 A shall be equipped with a cutout (C43S) mounted in series with a coordinated CLF (F7A).

12.5.40 Line Switches - Single Blade

Open-type cutouts with a solid blade (C43S) are recommended for 5 kV circuits. Open-type cutouts or disconnect switches (C43S or D5D) depending upon load characteristics with loadbuster hooks shall be used on 15 kV circuits or 5 kV circuits that will be converted in the near future. In-line disconnect switches as shown on Page 12-138, are recommended where clearances will not allow switch installation on crossarms.

In order to provide superior customer service, avoid the single-phasing of loads, and minimize the possibility of ferroresonance when energizing unloaded transformer banks, individually operated, single phase line switches should not be used on three phase lines.

12.5.50 Loadbreak Switches - Group Operated

In order to provide superior customer service, eliminate the effects of ferroresonance, improve upon interruption duration indexes and simplify operating requirements on critical feeder sections, the use of group operated loadbreak switch devices is recommended on three phase lines.

Generally, the appropriate use of three phase reclosers at major feeder bifurcation points and beyond critical loads should adequately segment the feeder load into reasonable load groups, 2.5MVA or less. Group operated loadbreak switch devices should be used in the following circumstances:

A. Normally open tie points between feeders fed from two sources.
B. Long three phase underground and/or delta circuits.
C. Critical load (e.g. hospitals, prisons, shopping centers, ect.) that can be fed from two alternative sources with normally open ties.
D. Key tie points that are frequently utilized (two or more times a year).
E. First switch away from substation riser pole.
F. On the delta side of a floating wye-delta step-down bank.

Operating mechanism shall be locked in the open or closed position.

All new Loadbreak Switch installations are to be installed on a Class H1 pole with a Fiberglass double deadended crossarm or adjacent poles must be upgraded to meet the Requirements of Section 4 – Storm Hardening. Refer to Standards 12-141 to 12-145.

12.5.60 Regulator By-pass Switch

A non-loadbreak, sequenced, make-before-break switch, designed to by-pass and safely disconnect a regulator from the line once the regulator is in the neutral position. See Section 15 for construction details.

12.5.70 Line Breakers

A. Three Phase Reclosers

Line reclosers enhance safety, improve customer reliability, and offer load side fault protection. Their general function is to sense and interrupt fault current, re-energize the line if the fault is of a temporary nature, and sectionalize non self-clearing faulted sections of distribution circuits. They may also be installed in loop sectionalizing applications or be supervisory controlled to improve distribution system reliability.

The SEL-651R control is specified for use with the G&W Viper-S recloser head. There is one SEL-651R control that can be applied to: radial installations; sectionalizing and tie reclosers in loop scheme configurations; and automatic source transfer applications. Separate controls are no longer needed for different system applications. Recloser control cabinets shall include proper identification including documentation on the inside door and appropriate labeling on the outside door.

All new 3 Phase Reclosers are to be installed on a Class H1 pole or adjacent poles upgraded to H1 poles with fiberglass double deadends to meet the requirements of Section 4 – Storm Hardening

1. Radial Recloser Applications

Radial reclosers operate as overcurrent protective devices. Radial applications require a 120 V supply from the source side for control and closing functions. In addition, the control can also accommodate a 120 V supply from the load side for AC transfer capability. The load side supply shall be connected when practical or as required (e.g. back-feeds, reliability). The 120 V supplies shall be connected to the X1 leg to assure correct 3 phase power analog values.

General 15kV and 35kV class recloser packages are furnished by the manufacturer as pre-wired, site ready units. These recloser packages require Company supplied transformation to meet the recloser and control power requirements. If Company owned secondary exists on a structure where a radial recloser is to be installed, the existing secondary may be used to meet the power requirements. If a possibility of backfeed exists, control requires both source and load side single phase secondary supplies. Therefore, the secondary crib must be split at the recloser structure. Both source and load side secondary supplies can be fed from any phase; however, phasing must be noted and accounted for in the control settings. It is not necessary for these 120 V secondary supplies to be in phase due to the break-before-make nature of the AC transfer switch.

Voltage specific recloser packages are available for 12.47 kV, 13.2 kV and 13.8 kV applications. These packages are furnished by the manufacturer as pre-wired, site ready units and include two frame mounted potential transformers to meet the recloser and control power requirements. As such, voltage specific recloser packages do not require additional Company supplied transformation.

Figure 1 shows a typical application for radial recloser controls.

Supersedes 7/14 Issue – Updated Titles to reflect Three Phase Reclosers

Supersedes 1/09 Issue – Removed ' Loop Recloser Control' Section, Added ' Loop Scheme Recloser Applications' Section for 800A G&W

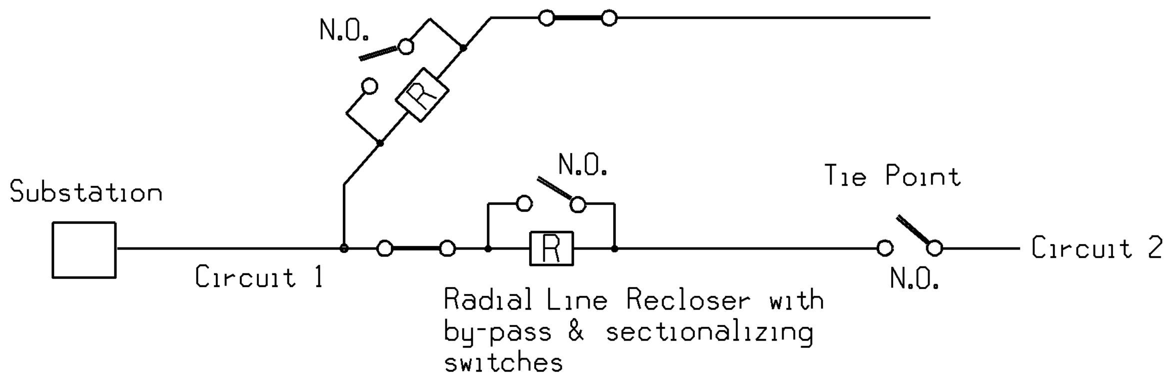


Figure 1 – Radial Application

2. Loop Scheme Recloser Applications

Loop scheme reclosers protect against overcurrent and automatically isolate the faulted section of a feeder, minimizing the outage duration for customers not directly affected. Reconfiguration is done based on loss of voltage detection, and it does not require any type of remote communications to function. These applications automatically isolate a faulted section of a feeder and restore power to the unaffected sections of the feeder, normally within one minute. Since most faults are transient in nature, loop sectionalizing applications must be programmed to only function when the substation breakers or line reclosers trip to lockout indicating a permanent fault has occurred.

The SEL-651R control requires a 3 phase 120 V supply for the control and closing functions on both sides of the tie recloser and on the source side of the sectionalizing recloser. In addition, the sectionalizing recloser requires 120 V supply on the load side.

General 15kV and 35kV class recloser packages are furnished by the manufacturer as pre-wired, site ready units. Loop scheme sectionalizing recloser applications require dedicated Company supplied three phase, source side transformation for both voltage sensing and control power. In addition, the sectionalizing recloser requires a single phase 120 V supply on the load side. This load side secondary supply can be fed from any phase; however, phasing must be noted and accounted for in the control settings. Loop scheme tie recloser applications require dedicated Company supplied three phase transformation on both the Source 1 ("line") and Source 2 ("load") sides of the recloser.

Voltage specific recloser packages are available for 12.47 kV, 13.2 kV and 13.8 kV applications. These packages are furnished by the manufacturer as pre-wired, site ready units and include two frame mounted potential transformers to meet the recloser and control power requirements, as well as three phase integrated voltage sensing on the Source 1 ("line"), horizontal bushings. As such, these voltage specific recloser packages do not require additional Company supplied transformation for loop scheme sectionalizing applications. However, a tie recloser application requires additional Company supplied three phase transformation on the Source 2 ("load") side to accommodate voltage sensing capability on both sides of the device.

Figure 2 shows a typical application for loop recloser controls.

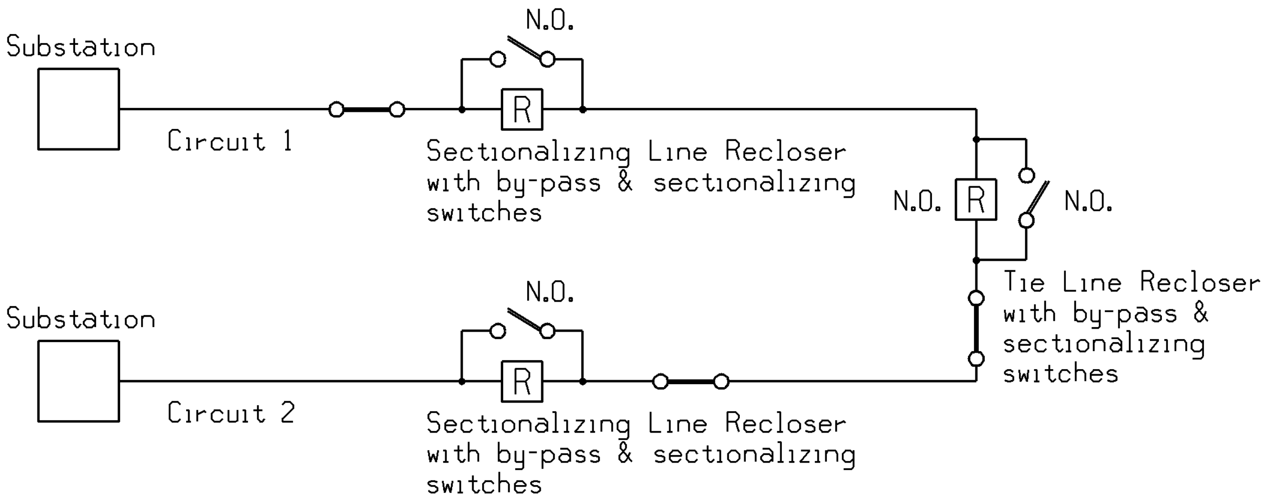


Figure 2 – Loop Application

Note: Alternate controls in-service may differ from current standard. Some include Cooper DC Nova, Cooper 3A, Cooper 4C, Cooper F5, Cooper F6, Joslyn Faultmaster, and Schweitzer 351R. The operation of all these alternatives achieves the same result.

3. Recloser Junction Box

The junction box is supplied pre-wired and includes Source 1 and Source 2 120 V input cables as well as a 19-position AC supply cable and 14-position control cable for bringing the signals to the control cabinet and recloser head. All power and control cables are provided and shall be connected as shown in the drawings. The junction box wiring diagrams indicate connections for radial, sectionalizing, and tie recloser applications, which require 120 V supply for control and closing. Radial applications that utilize single phase 120 V for control and closing, shall have 2-conductor Source 1 and Source 2 secondary supply cables where the black (120 V) and the white (neutral) wires shall be connected to the 120 V supply or supplies. General loop scheme applications shall have 4-conductor Source 1 and Source 2 secondary supply cables and may not require that all four conductors be connected on the Source 2 side (e.g., sectionalizing applications). Therefore, the red conductor should be connected and the unused black and orange conductors taped back at the supply cable breakout coming from the junction box.

B. <u>Sectionalizers</u>

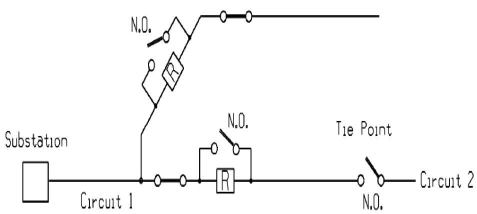
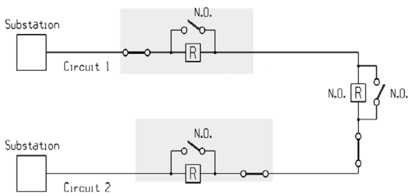
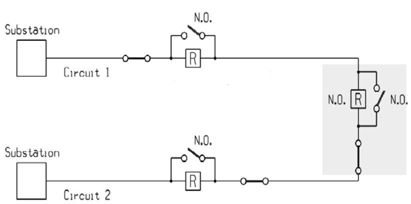
Use of sectionalizers on the Company distribution system is not recommended. They shall be restricted to those few locations where coordination of a recloser cannot be obtained.

Sectionalizers are designed to isolate permanent faults involving primary circuits while allowing an upstream device to clear transient faults. The sectionalizer detects loss of line voltage and will either open or close, as required, after a programmed outage interval.

Supersedes 1/09 Issue – Edited ' Recloser Junction Box' Section to Incorporate New 800A G&W Recloser Junction Box

Supersedes 7/15 Issue – Corrected typos in three locations.

G&W Viper Recloser Application Table

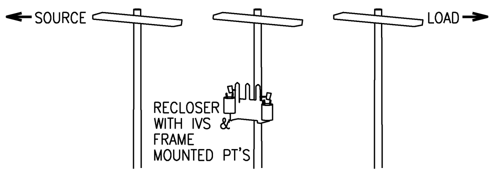
Application	Type	Requirements	Std Item
Radial 	General Recloser Package	120V 1P supply from the **line** side for control and closing functions. Optional: **load** side 120V 1P supply for back-feeds and reliability.	R50AA R50FF R50FS
	Voltage Specific Package	12.47/13.2/13.8kV have 2 frame mtd PT's- requires no Company supplied transformation.	R50A1, R50A2, R50A3
Loop Scheme Sectionalizing 	General Recloser Package	Requires dedicated Company supplied 3 phase **line** side transformation for voltage sensing and control power. Requires Company supplied 120 volt 1P supply on the **load** side.	R50EE R50GG R50GS
	Voltage Specific Package	12.47/13.2/13.8kV have 2 frame mtd PT's and 3 phase Integrated Voltage sensing on the **Line** side. No Company supplied transformation required.	R50E1, R50E2, R50E3
Loop Scheme Tie 	General Recloser Package	Requires dedicated Company supplied 3 phase **line** side and **load** side transformation for voltage sensing and control power.	R50EE R50GG R50GS
	Voltage Specific Package	12.47/13.2/13.8kV have 2 frame mtd PT's and 3 phase Integrated Voltage sensing on the on the **line** side. Company supplied 3P transformation on the **load** side is required. Requires an additional 15' - 4 conductor cable (R52D or R52C).	R50E1, R50E2, R50E3
Sub T Sectionalizer	35kV Recloser Package	35kV with 3 phase Integrated Voltage sensing on the line and load side. Requires Company supplied 120 volt 1P supply on the line and load side for the control.	R50HA

G&W VIPER RECLOSER APPLICATION GUIDE

NGRID SYSTEM VOLTAGES	OLD STD ITEMS	CT RATIO	PACKAGE	MECHANISM STD ID	CT RATIO	PACKAGE	MECHANISM STD ID	RADIAL MIDLINE LOOP SCHEME PHYSICAL	RADIAL MIDLINE LOOP SCHEME WIRING	PCC PHYSICAL	PCC WIRING	PCC ONE LINE NY	PCC ONE LINE NE
3,740GRDY/2160 4,160GRDY/2,400	R50AA / R50EE R50AA / R50EE	1000/500:1	D	R50S15B	–	–	–	12–338	12–339	12–338A	12–339	12–11	12–11A
12,470GRDY/7,200 13,200GRDY/7,600 13,800GRDY/7,960	R50A1 / R50E1 R50A2 / R50E2 R50A3 / R50E3	1000/500:1	C	R50S15C	400/200:1	F	R50S15C1	12–338	12–339	12–338A	12–339	12–11	12–11A
24,940GRDY/14,400 34,500GRDY/19,900 23,000Y 34,500Y	R50FF / R50GG / R50HA R50FF / R50GG / R50HA R50FF / R50GG / R50HA R50FF / R50GG / R50HA	1000/500:1	E	R50S38A	400/200:1	H	R50S38A1	12–950	12–951	12–950A	12–951	12–12	12–12A
2,400Δ 8,320GRDY/4,800 4,800Δ 7,200Δ 11,000Δ 12,000Δ 13,800Δ	R50AA / R50EE R50AA / R50EE R50AA / R50EE R50AA / R50EE R50AA / R50EE R50AA / R50EE R50AA / R50EE	1000/500:1	A	R50S15A	400/200:1	G	R50S15A1	12–335	12–336	12–335A	12–336	12–10	12–10A
23,000Δ 34,500Δ	R50FS / R50GS R50FS / R50GS	1000/500:1	B	R50S38B	400/200:1	J	R50S38B1	12–950	12–952	12–950A	12–952	12–13	12–13A

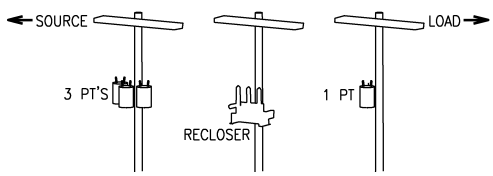
PACKAGE C D F

GENERAL ARRANGEMENT FOR 3Ø RECLOSER INSTALLATION
DETAILS 15KV WITH IVS AND FRAME MOUNTED PT'S



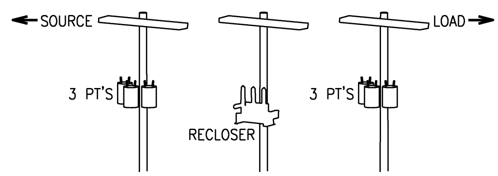
PACKAGE A AND G

RADIAL/PCC/LOOP SCHEME SECTIONALIZER
ARRANGEMENT FOR 3Ø RECLOSER INSTALLATION
DETAILS 15kV WITH EXTERNAL MOUNTED PT'S



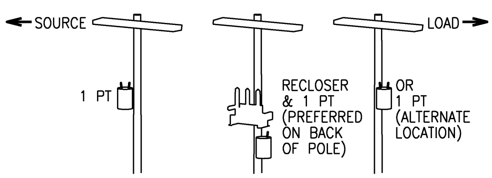
PACKAGE A AND G

MIDLINE/LOOP SCHEME TIE ARRANGEMENT
FOR 3Ø RECLOSER INSTALLATION DETAILS
15kV WITH EXTERNAL MOUNTED PT'S



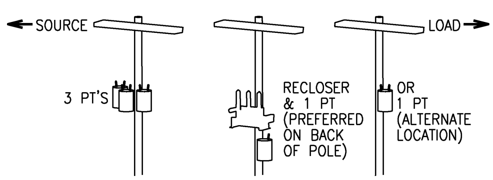
PACKAGE E AND H

GENERAL ARRANGEMENT FOR 3Ø
RECLOSER INSTALLATION DETAILS 38kV
WITH IVS AND EXTERNAL MOUNTED PT'S



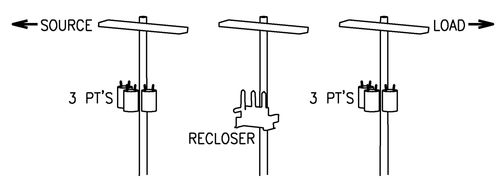
PACKAGE B AND J

RADIAL/PCC/LOOP SCHEME SECTIONALIZER
ARRANGEMENT FOR 3Ø RECLOSER INSTALLATION
DETAILS 38kV WITH EXTERNAL MOUNTED PT'S



PACKAGE B AND J

MIDLINE/LOOP SCHEME TIE ARRANGEMENT
FOR 3Ø RECLOSER INSTALLATION DETAILS
38kV WITH EXTERNAL MOUNTED PT'S



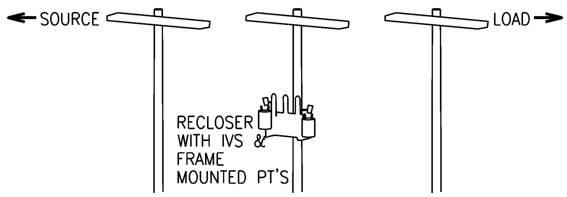
Designer	Drawing	Date
MPR	od1209A	7/15/19

COOPER/EATON NOVA NX-T RECLOSER APPLICATION GUIDE

NGRID SYSTEM VOLTAGES	CT RATIO	PACKAGE	MECHANISM STD ID	PHYSICAL	WIRING
3,740GRDY/2160 4,160GRDY/2,400	1000/500:1	P	R50SE15B	12-350	12-351
12,470GRDY/7,200 13,200GRDY/7,600 13,800GRDY/7,960	1000/500:1	Q	R50SE15C	12-350	12-351
24,940GRDY/14,400 34,500GRDY/19,900 23,000Y 34,500Y	1000/500:1	R	R50SE38A	12-960	12-961

PACKAGE P Q

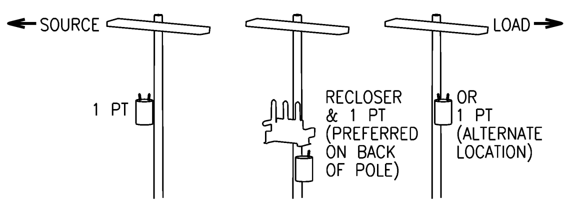
GENERAL ARRANGEMENT FOR 3ø RECLOSER INSTALLATION DETAILS 15KV WITH IVS AND FRAME MOUNTED PT'S



7/20 - New page

PACKAGE R

GENERAL ARRANGEMENT FOR 3ø RECLOSER INSTALLATION DETAILS 38kV WITH IVS AND EXTERNAL MOUNTED PT'S



Designer	Drawing	Date
MPR	od1209B	4/17/20

C. Distributed Generation Installations

TYPICAL LARGE DISTRIBUTED GENERATION INTERCONNECTION DESIGNS

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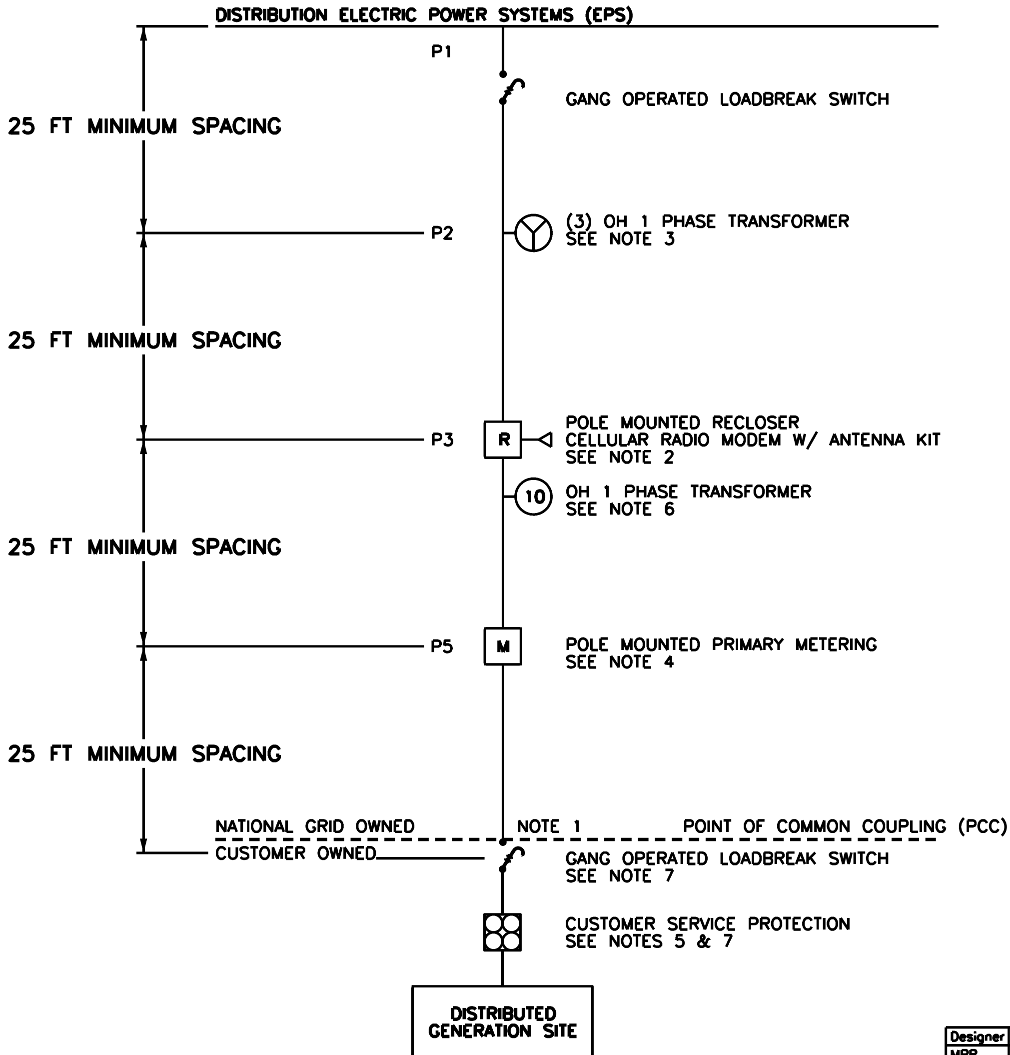
DISTRIBUTION OH DER – NE



Designer	Drawing	Date
MPR	od1210A	7/15/19

NOTE:

1. NATIONAL GRID TO INSTALL DEADEND INSULATORS & PRIMARY CONDUCTORS TO CUSTOMER GUYED STRUCTURE. NATIONAL GRID TO PROVIDE TAPS & NEMA TERMINAL LUGS AND WILL MAKE FINAL CONNECTIONS TO CUSTOMER SWITCH. EXCEPTIONS TO GUYING CUSTOMER STRUCTURE ARE PER PRIOR COMPANY ENGINEERING APPROVAL.
2. POLE MOUNTED RECLOSER INSTALLATION PER STANDARD 12-335A.
3. UTILITY SOURCE SIDE REQUIRES THREE (3) SEPARATE TRANSFORMERS. THESE TRANSFORMERS WILL REQUIRE MOUNTING ON AN SEPARATE POLE. TO MINIMIZE EQUIPMENT INSTALLATIONS, MOUNTING THE TRANSFORMERS ON THE NEAREST EXISTING ADJACENT POLE IS DESIRED. TRANSFORMERS SHOULD BE MOUNTED ON THE LOAD SIDE OF THE GANG OPERATED SWITCH.
4. PRIMARY METERING, NATIONAL GRID TO FURNISH AND INSTALL METER CLUSTER ARRANGEMENT. THE CUSTOMER MUST PROVIDE SUFFICIENT CONDUCTOR TO ALLOW THE COMPANY TO MAKE FINAL CONNECTIONS AT THE METER POLE. THE COMPANY WILL PROVIDE FINAL CONNECTION OF THE CUSTOMER CONDUCTORS TO THE COMPANY METER. PRIMARY METERING, STRUCTURE/ POLE OWNED BY NATIONAL GRID.
5. DG OWNER TO PROVIDE SYSTEM PROTECTION AS REQUIRED TO PROTECT THEIR SERVICE EQUIPMENT.
6. TRANSFORMER MAY BE MOUNTED ON BACK OF RECLOSER STRUCTURE WITH OPERATIONS APPROVAL. WHERE MOUNTING ARRANGEMENT CANNOT BE INSTALLED, AN ADDITIONAL POLE WITH 25'-0" MINIMUM SPACING WILL BE REQUIRED (NOT SHOWN).
7. FOR REFERENCE ONLY, SPECIFIC CUSTOMER SERVICE REQUIREMENTS ARE COVERED IN THE ELECTRIC SERVICE BULLETIN SERIES.

Supersedes 7/18 Issue-Revised drawing description and title.

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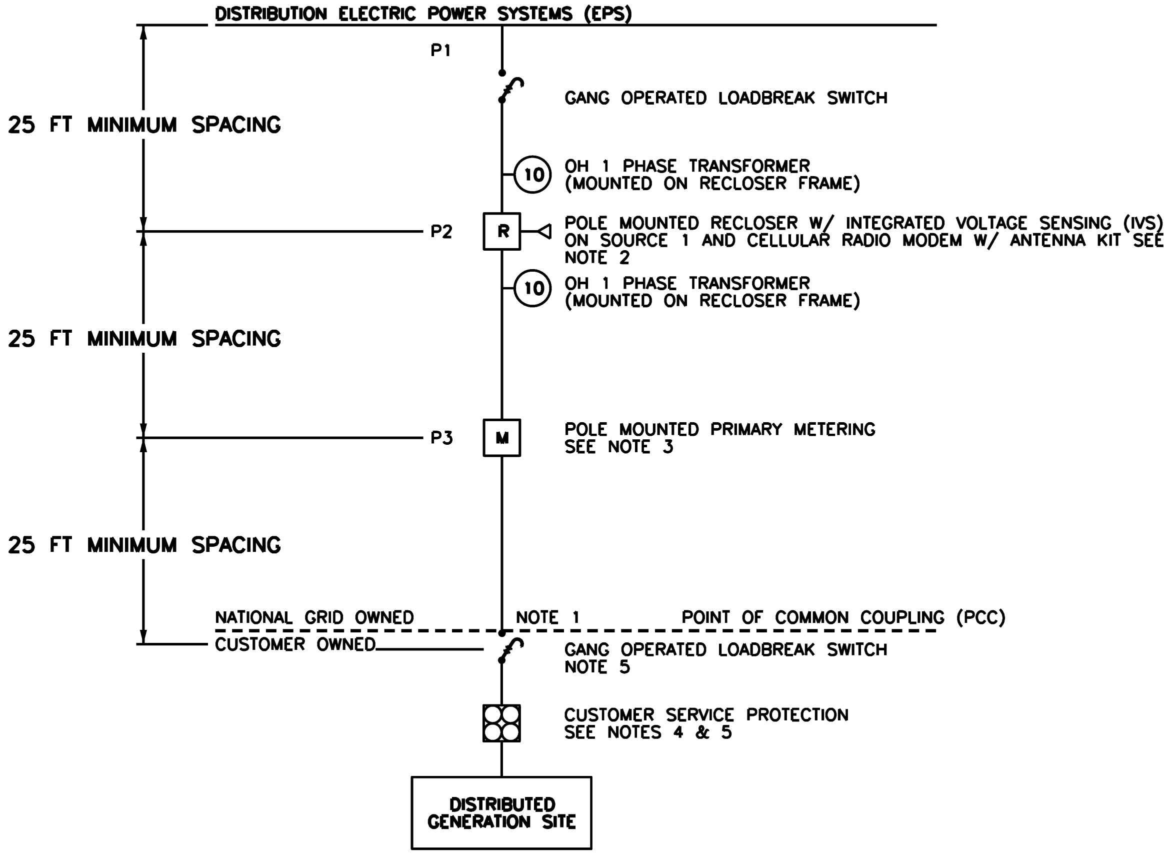
DISTRIBUTION OH DER – NE



Designer	Drawing	Date
MPR	od1211A	7/15/19

NOTE:

1. NATIONAL GRID TO INSTALL DEADEND INSULATORS & PRIMARY CONDUCTORS TO CUSTOMER GUYED STRUCTURE. NATIONAL GRID TO PROVIDE TAPS & NEMA TERMINAL LUGS AND WILL MAKE FINAL CONNECTIONS TO CUSTOMER SWITCH. EXCEPTIONS TO GUYING CUSTOMER STRUCTURE ARE PER PRIOR COMPANY ENGINEERING APPROVAL.
2. POLE MOUNTED RECLOSER INSTALLATION PER STANDARD 12-338A.
3. PRIMARY METERING, NATIONAL GRID TO FURNISH AND INSTALL METER CLUSTER ARRANGEMENT.
4. DG OWNER TO PROVIDE SYSTEM PROTECTION AS REQUIRED TO PROTECT THEIR SERVICE EQUIPMENT.
5. FOR REFERENCE ONLY, SPECIFIC CUSTOMER SERVICE REQUIREMENTS ARE COVERED IN THE ELECTRIC SERVICE BULLETIN SERIES.

Supersedes 7/18 Issue-Revised drawing description and title.

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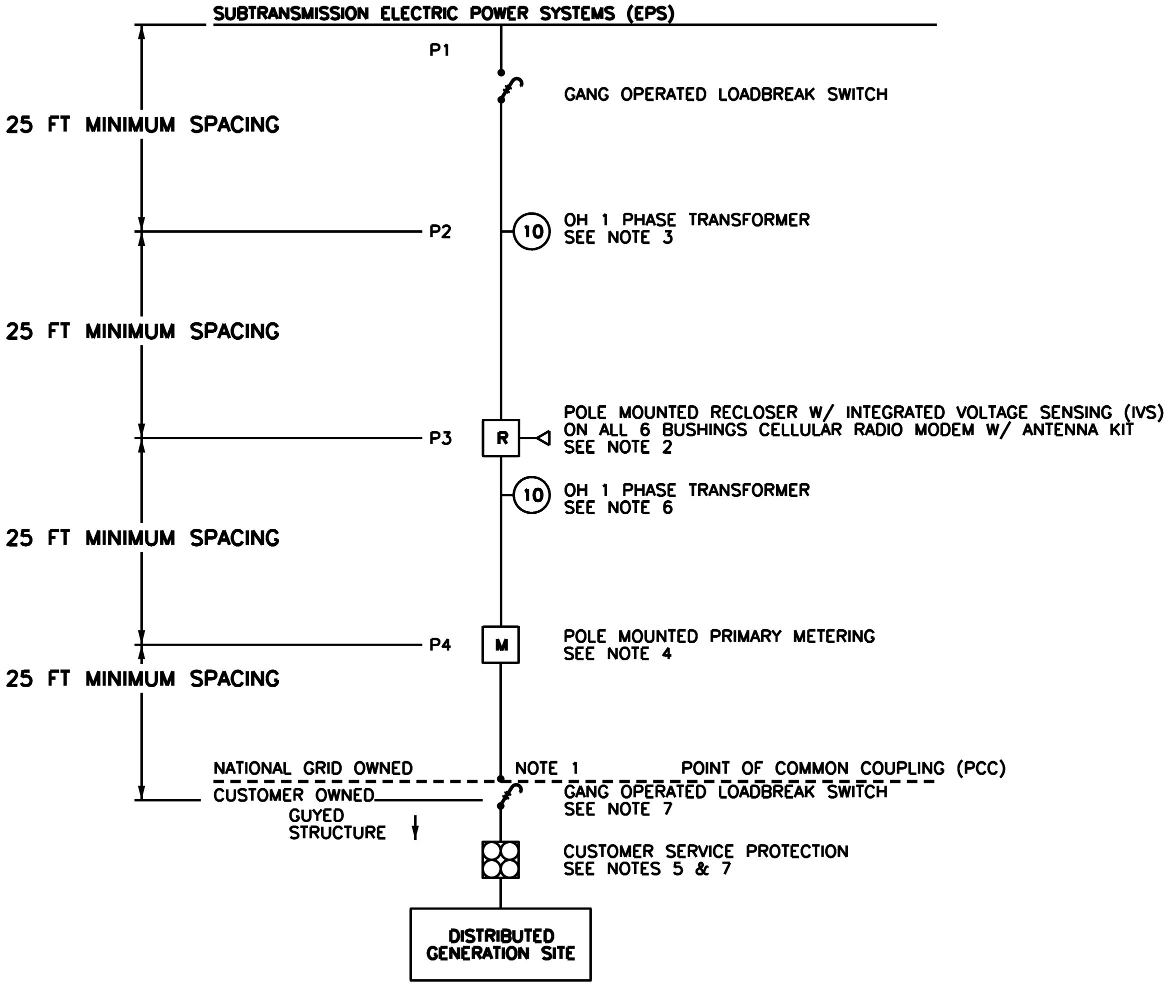
SUBTRANSMISSION OH DER – NE



Designer	Drawing	Date
MPR	od1212A	7/15/19

NOTE:

1. NATIONAL GRID TO INSTALL DEADEND INSULATORS & PRIMARY CONDUCTORS TO CUSTOMER GUYED STRUCTURE. NATIONAL GRID TO PROVIDE TAPS & NEMA TERMINAL LUGS AND MAKE FINAL CONNECTIONS TO CUSTOMER SWITCH. EXCEPTIONS TO GUYING CUSTOMER STRUCTURE ARE PER PRIOR COMPANY ENGINEERING APPROVAL.
2. POLE MOUNTED RECLOSER INSTALLATION PER STANDARD 12-950A.
3. UTILITY SOURCE SIDE REQUIRES ONE (1) EXTERNAL TRANSFORMER (34500 GRD Y/19920=120/240). THE UTILITY SIDE TRANSFORMER WILL REQUIRE MOUNTING ON A SEPARATE POLE. TO MINIMIZE EQUIPMENT INSTALLATIONS, MOUNTING THE TRANSFORMER ON THE NEAREST EXISTING ADJACENT POLE IS DESIRED. IDEALLY THE TRANSFORMER WOULD BE MOUNTED AS TO BE WITHIN THE RECLOSER ZONE OF ISOLATION, ALTHOUGH THIS IS NOT NECESSARY AS THE TRANSFORMER CAN BE ISOLATED VIA FUSE HOLDER.
4. PRIMARY METERING, NATIONAL GRID TO FURNISH AND INSTALL METER CLUSTER ARRANGEMENT.
5. DG OWNER TO PROVIDE SYSTEM PROTECTION AS REQUIRED TO PROTECT THEIR SERVICE EQUIPMENT.
6. IT IS ENGINEERING PREFERENCE TO MOUNT TRANSFORMER ON BACK OF RECLOSER STRUCTURE WITH OPERATIONS APPROVAL. WHERE MOUNTING ARRANGEMENT CANNOT BE INSTALLED, AN ADDITIONAL POLE WITH 25'-0" MINIMUM SPACING WILL BE REQUIRED (NOT SHOWN).
7. FOR REFERENCE ONLY, SPECIFIC CUSTOMER SERVICE REQUIREMENTS ARE COVERED IN THE ELECTRIC SERVICE BULLETIN SERIES.
8. MINIMUM POLE SPACING IS 25' ALONG A CENTERLINE WITH A 37.5' RIGHT OF WAY ON EACH SIDE.

Supersedes 7/18 Issue-Revised drawing description and title.

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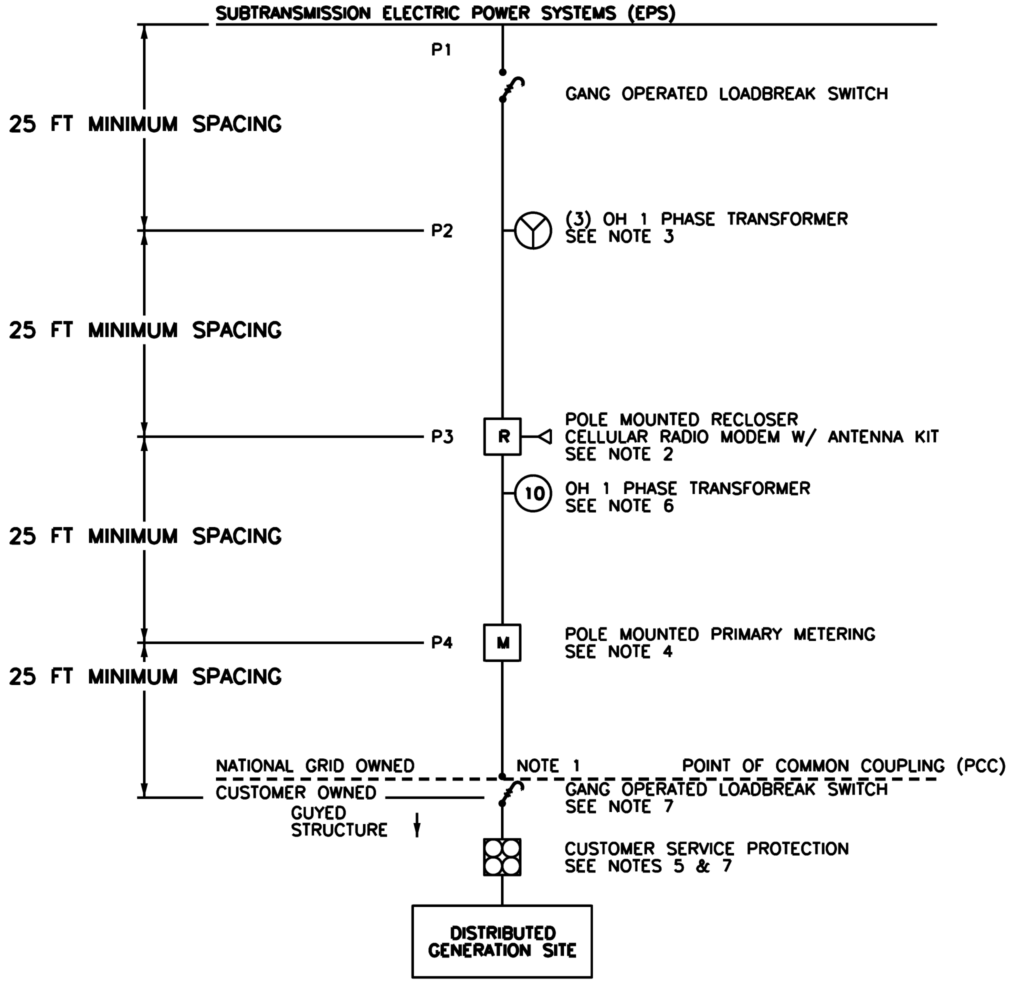
New drawing.

SUBTRANSMISSION OH DER – NE



Designer	Drawing	Date
MPR	od1213A	6/3/19

NOTE:

1. NATIONAL GRID TO INSTALL DEADEND INSULATORS & PRIMARY CONDUCTORS TO CUSTOMER GUYED STRUCTURE. NATIONAL GRID TO PROVIDE TAPS & NEMA TERMINAL LUGS AND MAKE FINAL CONNECTIONS TO CUSTOMER SWITCH. EXCEPTIONS TO GUYING CUSTOMER STRUCTURE ARE PER PRIOR COMPANY ENGINEERING APPROVAL.
2. POLE MOUNTED RECLOSER INSTALLATION PER STANDARD 12-950A.
3. UTILITY SOURCE SIDE REQUIRES THREE (3) SEPARATE TRANSFORMERS. THESE TRANSFORMERS WILL REQUIRE MOUNTING ON AN SEPARATE POLE. TO MINIMIZE EQUIPMENT INSTALLATIONS, MOUNTING THE TRANSFORMERS ON THE NEAREST EXISTING ADJACENT POLE IS DESIRED. TRANSFORMERS SHOULD BE MOUNTED ON THE LOAD SIDE OF THE DISCONNECT SWITCH.
4. PRIMARY METERING, NATIONAL GRID TO FURNISH AND INSTALL METER CLUSTER ARRANGEMENT.
5. DG OWNER TO PROVIDE SYSTEM PROTECTION AS REQUIRED TO PROTECT THEIR SERVICE EQUIPMENT.
6. IT IS ENGINEERING PREFERENCE TO MOUNT TRANSFORMER ON BACK OF RECLOSER STRUCTURE WITH OPERATIONS APPROVAL. WHERE MOUNTING ARRANGEMENT CANNOT BE INSTALLED, AN ADDITIONAL POLE WITH 25'-0" MINIMUM SPACING WILL BE REQUIRED (NOT SHOWN).
7. FOR REFERENCE ONLY, SPECIFIC CUSTOMER SERVICE REQUIREMENTS ARE COVERED IN THE ELECTRIC SERVICE BULLETIN SERIES.
8. MINIMUM POLE SPACING IS 25' ALONG A CENTERLINE WITH A 37.5' RIGHT OF WAY ON EACH SIDE.

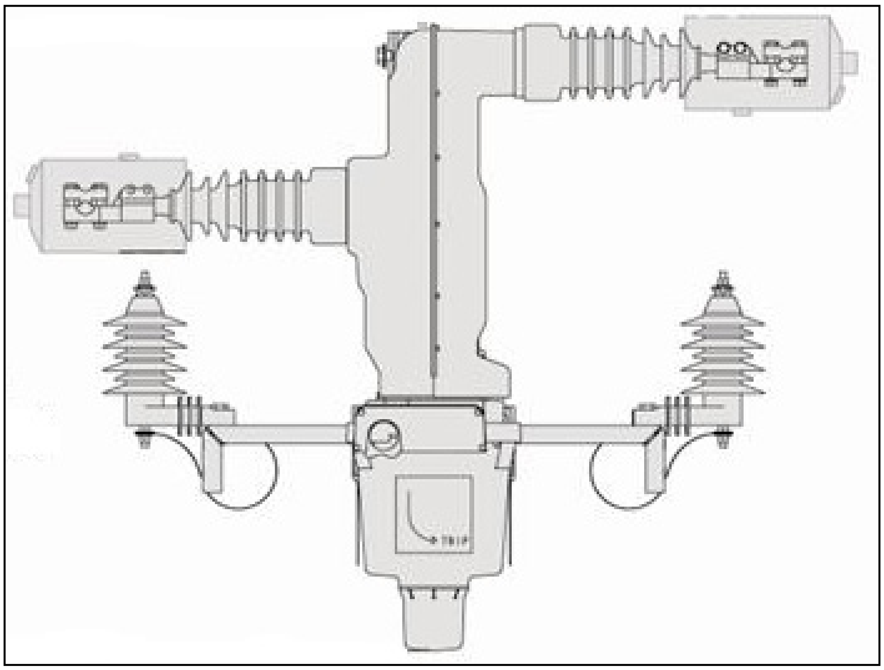
D. Single Phase Radial Recloser

Single Phase Radial reclosers operate as overcurrent protective devices for locations where the Cutout Mounted Recloser is not an option such as high fault current areas or single phase loads over 100 amps.

The recloser is designed for automatic or manual operation providing overcurrent protection for up to15kV single phase systems, 110 kV BIL, 800A continuous current, and 12.5kA rms symmetrical interrupting.

The Single Phase Recloser requires a Schweitzer SEL-351RS Kestrel control mounted on the pole. The control requires a 120 V supply from the source side for control and closing functions. Units are shipped Site-ready with all accessories including bracket, arresters and control with control and power wiring. A 200amp cutout shall be used as a bypass. Cutout body shall be stapled to the pole when not in bypass mode. A sectionalizing switch shall be installed on an adjacent source side pole or inline.

Z Configuration Single Phase Recloser



E. Cutout-Mounted Recloser

The cutout mounted recloser is a self-powered, electronically controlled, single phase, vacuum fault interrupter mounted with the included factory shipped fuse cutout.The sole approved manufacturer requires the unit to be mounted in an MacLean Power Systems Type XS fuse cutout mounting (Poly type - factory shipped with the unit)

Application:

- 15kV and below circuits (Single phase or Three Phase fuse taps)
- Basic Insulation Level (BIL) of 110kV.
- The maximum continuous current carrying capability is 100 amperes.
- Symmetrical Interrupting rating is 6300 amperes.
- To be installed on single crossarms or a C35 bracket.
- Tag Holder to be installed on pole.

Operating Sequence:

- All units are factory programmed for seven fuse size curves – 40K, 65K, 100K with one reclose.
- The opening interval between operations is 5 seconds. The interrupter resets 2 seconds after dropping open. The operator can then reclose the unit back into the mounting.
- The device must be opened manually with a Loadbuster tool.

NOTE: Limited amounts of the original cutout-mount recloser may still be installed in isolated areas. They do not have the LED indicator screen that indicates the status of life left for operation. When they have reached their limit they will not close and can be replaced with the current available cutout-mount recloser.

Location, Application and Setup of this device must be done under direction of Electric Operations Engineering.

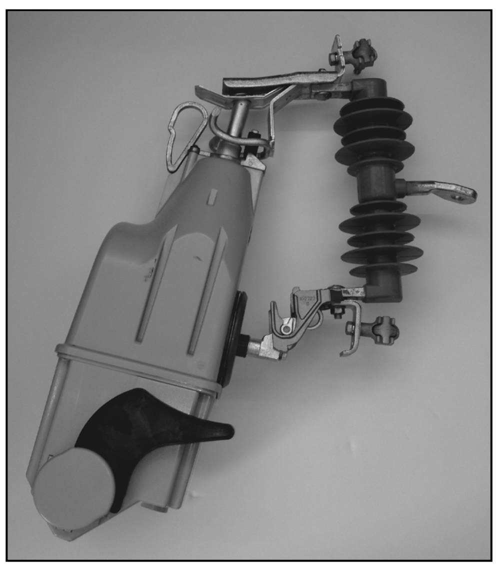


Figure 3 – Cutout Mounted Recloser

Supersedes 7/19 Issue – Update text

12.6 FAULT CIRCUIT INDICAT

Automatic reset type Fault Circuit Indicators (FCI) are available and are used in an attempt to reduce operating call out time by helping to pinpoint circuit faults. If a fault occurs, a target on the indicator appears or changes color. The Fault Indicators have an automatic load leveling with load memory that enables the unit to automatically set the fault trip threshold in relation to the peak load current.

There are various types of FCIs installed onto the Company's overhead distribution system, which operate as follows:

Automatic Reset - If there is a fault, the red indicating target gives the device a strikingly different appearance. When the line is re-energized with the fault removed, the red indicating target will reset instantaneously.

Time Delay Reset - If there is a fault, the red and yellow indicating targets give the device a strikingly different appearance. When the line is re-energized, with the fault removed, the red indicating target will reset while the yellow indicating target resets within a prescribed time delay. The time delay is identified on the unit and is not adjustable.

Manual Reset - If there is a fault, the red indicating target gives the device a strikingly different appearance. When the line is re-energized, with the fault removed, the red indicating target will remain until it is manually reset with the magnetic reset tool (F2T) by the line worker.

12.6.10 Radial Applications

FCI's should be used at selected locations such as:

A. Unfused 3 phase lines.
B. Unfused single phase lines.
C. Load side of 3 phase switches.
D. Load side of 3 phase sectionalizers.
E. Locations not easily accessible by line worker personnel (e.g. rights-of-way, campgrounds, etc.)

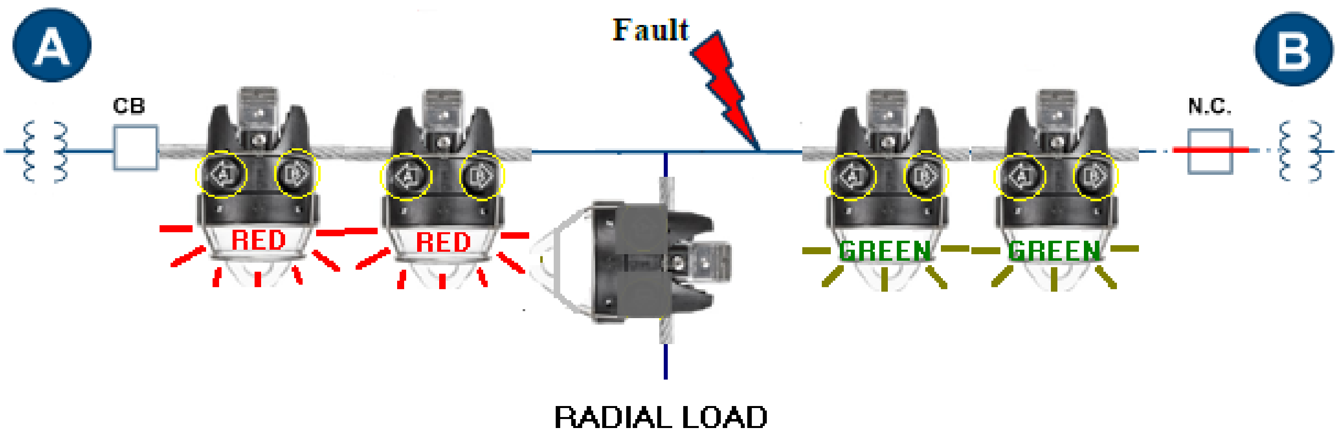
Note: When the time delay reset type FCIs are first installed, and there is more current then the minimum trip setting, the FCI needs to adjust and then will begin to flash. The red LEDs will turn off within 1 minute if there is no fault current, and the yellow LEDs will turn off in 4, 8 or 24 hour (depending on time reset).

12.6.20 Network Applications

Directional Fault indicators are to be used on “Network” circuits with multiple Fault Indicator site installations. The Source A and Source B must be determined. All of the indicators must be oriented such that the “A” marking faces toward the Source A and the “B” marking faces toward the Source B. Failure to properly orient the indicators will result in false readings during a fault. Engineering will create a “Fault Indicator Guide” identifying the locations of the Fault Indicators on each feeder to assist with locating the fault on “Network” feeders.

EXAMPLE OF A NETWORK APPLICATION

Proper installation of Directional Fault indicators (Note the A & B indicators on the units should be pointing to the source).
Fault location can be identified between the Red and Green blinking indicators on a “Network” circuit.



7/20 Added Smart Indicators

12.6.30 Smart Indicators – Fault Circuit

Smart Indicators can be used as a stand-alone device on circuits up to 161 kV or can be integrated into an existing Smart Grid System leveraging various communications environments for OMS and SCADA Applications. Requires the use of a collector box to collect and manage data from the Smart Indicators via a local RF connection, as an access point into a communication network. Up to 12 Smart Indicators can communicate to one collector box within 100’ line of sight.

12.7 INSTALLATION - CUTOUTS & DISCONNECTING DEVICES

Typical installations are shown on Pages 12-127 through 12-333. Cutouts should be turned toward the pole for easier opening. Disconnect switches should be installed so that normally the blade opens away from the circuit source. In addition, the location of all disconnecting devices shall be chosen to minimize the possibility of an arc flaring up, or being blown into other circuits.

All mainline switching devices shall be properly numbered and located per construction drawing requirements.

Conductors inserted into the terminals of cutouts and disconnects shall be copper or electrically equivalent aluminum. Hyseal plugs (S27H or S27J) are available for terminating aluminum conductors in cutouts.

CONVENTIONAL TRANSFORMER FUSING – SINGLE PHASE INSTALLATIONS															
PRIMARY CIRCUIT VOLTAGE	EACH TRANSFORMER TANK KVA SIZE														
	10	15	25	37	50	75	100	150	167	200	250	333	500	667	833
	ANSI TYPE_K FUSE LINK AMPERE RATING (F1K)														
2400 delta 2400/4160 Grd. Y	10	15	25	40	40	65	65	100	100		140				
4160 Ungrd. Y	6	10	15	25	25	40	40	65	65		100	140			
4800 delta 4800/8320 Grd. Y	6	10	15	25	25	40	40	65	65		100	140			
7200 delta 7200/12470 Grd. Y 7620/13200 Grd. Y 7970/13800 Grd. Y	3	6	10	10	15	25	25	40	40		65	65	100	140	200
12000 delta 13200 Ungrd. Y 13800 Ungrd. Y 13200/22860 Grd. Y 13800/23900 Grd. Y 14400/24900 Grd. Y	3	3	3	6	10	15	15	25	25		40	40	65	100	
23000 delta 19920/34500 Grd. Y	3	3	3	6	6	10	10	15	15		25	25	40	65	65

CONVENTIONAL TRANSFORMER FUSING – THREE PHASE INSTALLATIONS															
PRIMARY CIRCUIT VOLTAGE	EACH TRANSFORMER TANK KVA SIZE														
	10	15	25	37	50	75	100	150	167	200	250	333	500	667	833
	ANSI TYPE_K FUSE LINK AMPERE RATING (F1K)														
2400 delta	15	25	40	65	65	100	100	140	140	200	200				
2400/4160 Grd. Y 4160 Ungrd. Y	10	15	25	40	40	65	65	100	100	140	140	200			
4800 delta	10	15	25	40	40	65	65	100	100	100	140	140			
4800/8320 Grd. Y	6	10	15	25	25	40	40	65	65	65	100	140			
7200 delta 7200/12470 Grd. Y 7620/13200 Grd. Y 7970/13800 Grd. Y 12000 delta 13200 Ungrd. Y 13800 Ungrd. Y	3	6	10	10	15	25	25	40	40	40	65	65	100	140	200
13200/22860 Grd. Y 13800/23900 Grd. Y 14400/24900 Grd. Y 23000 delta	3	3	3	6	10	15	15	25	25		40	40	65	100	
19920/34500 Grd. Y	3	3	3	6	6	10	10	15	15		25	25	40	65	65

1. For open delta or Scott connections, fuse individual transformers the same as for single phase.
2. All fuses in standard three phase (3Φ) banks (same kVA ratings) shall be of the same rating maintaining consistent operating characteristics. Three phase (3Φ) transformers (T-T winding) are fused the same as an equivalent transformer bank of three single-phase transformers.
3. For non-standard banks (unlike kVA ratings) ONLY, fuse as follows:
   a. For wye or open delta, fuse individual transformers the same as for single phase.
   b. For closed delta banks, the two fuses feeding the larger transformer shall be fused for the size and voltage rating of the larger transformer. The fuse common to the smaller transformers shall be fused for the size and voltage rating of the smaller transformer.

(grey box) Non-standard Company application. If necessary, consult Standards Engineering

CONVENTIONAL TRANSFORMER FUSING – SINGLE PHASE INSTALLATIONS															
PRIMARY CIRCUIT VOLTAGE	EACH TRANSFORMER TANK KVA SIZE														
	10	15	25	37	50	75	100	150	167	200	250	333	500	667	833
	ANSI TYPE_T FUSE LINK AMPERE RATING (F1T)														
2400 delta 2400/4160 Grd. Y	6	10	15	25	40	40	65	100	100						
7200 delta 7200/12470 Grd. Y 7620/13200 Grd. Y 7970/13800 Grd. Y	3	3	6	10	10	10	15	25	25		40	65	100		

CONVENTIONAL TRANSFORMER FUSING – THREE PHASE INSTALLATIONS															
PRIMARY CIRCUIT VOLTAGE	EACH TRANSFORMER TANK KVA SIZE														
	10	15	25	37	50	75	100	150	167	200	250	333	500	667	833
	ANSI TYPE_T FUSE LINK AMPERE RATING (F1T)														
2400/4160 Grd. Y	6	10	15	25	40	40	65	100	100						
7200 delta 7200/12470 Grd. Y 7620/13200 Grd. Y 7970/13800 Grd. Y	3	3	6	10	10	10	15	25	25		40	65	100		

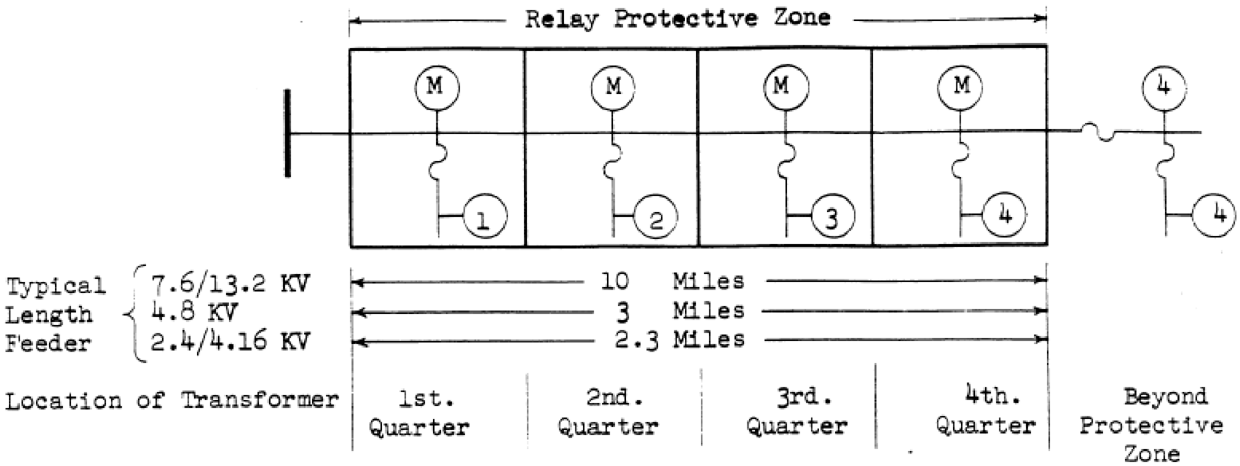
1. For open delta or Scott connections, fuse individual transformers the same as for single phase.
2. All fuses in standard three phase (3Φ) banks (same kVA ratings) shall be of the same rating maintaining consistent operating characteristics.
3. Three phase (3Φ) transformers (T-T winding) are fused the same as an equivalent transformer bank of three single-phase transformers.
4. For non-standard banks (unlike kVA ratings) ONLY, fuse as follows:
   c. For wye or open delta, fuse individual transformers the same as for single phase
   d. For closed delta banks, the two fuses feeding the larger transformer shall be fused for the size and voltage rating of the larger transformer. The fuse common to the smaller transformers shall be fused for the size and voltage rating of the smaller transformer.

Non-standard Company application. If necessary, consult Standards Engineering

CAPACITOR FUSING – 3Φ AND 1Φ PHASE INSTALLATIONS									
PRIMARY CIRCUIT VOLTAGE	**CAP (KV)**	**KVAR PER 3Φ/1Φ**							
		150/50	**300/100**	**450/150**	**600/200**	**900/300**	**1200/400**	**1800/600**	**2700/900**
		CAPACITOR VOLTAGE (KV)							
		ANSI TYPE_K FUSE LINK AMPERE RATING (F1K)							
2400 delta	**2.4**	40	80						
2400/4160 Grd. Y **4160 Ungrd. Y**	**2.4** **4.16**	20	40	65					
4800 delta	**4.8**	20	40	50	65				
4800/8320 Grd. Y	**4.8**	10	25	40	40	65			
6900 Ungrd. Y **7200 delta** **7200/12470 Grd. Y** **7620/13200 Grd. Y** **7970/13800 Grd. Y**	**6.64** **7.2** **7.6** **7.9**	10	15	20	30	40	65		
13200 Ungrd. Y **13800 Ungrd. Y** **13200/22860 Grd. Y**	**13.2** **13.8**				15	25	40	50	65
13800/23900 Grd. Y **14400/24900 Grd. Y**	**14.4**				15	25	40	40	65
19920/34500 Grd. Y	**19.9**					15	25	40	50
		ANSI TYPE_K FUSE LINK AMPERE RATING (F6K)							
23000 delta	**23**							50	80

1. Table is applicable for three phase (3Φ) & single phase (1Φ) installations.
2. This See C40 for standard capacitors & C36 for standard capacitor racks
3. Three phase (3Φ) capacitor units are fused the same as individual units utilizing the kVAR per three phase (3Φ) values above.

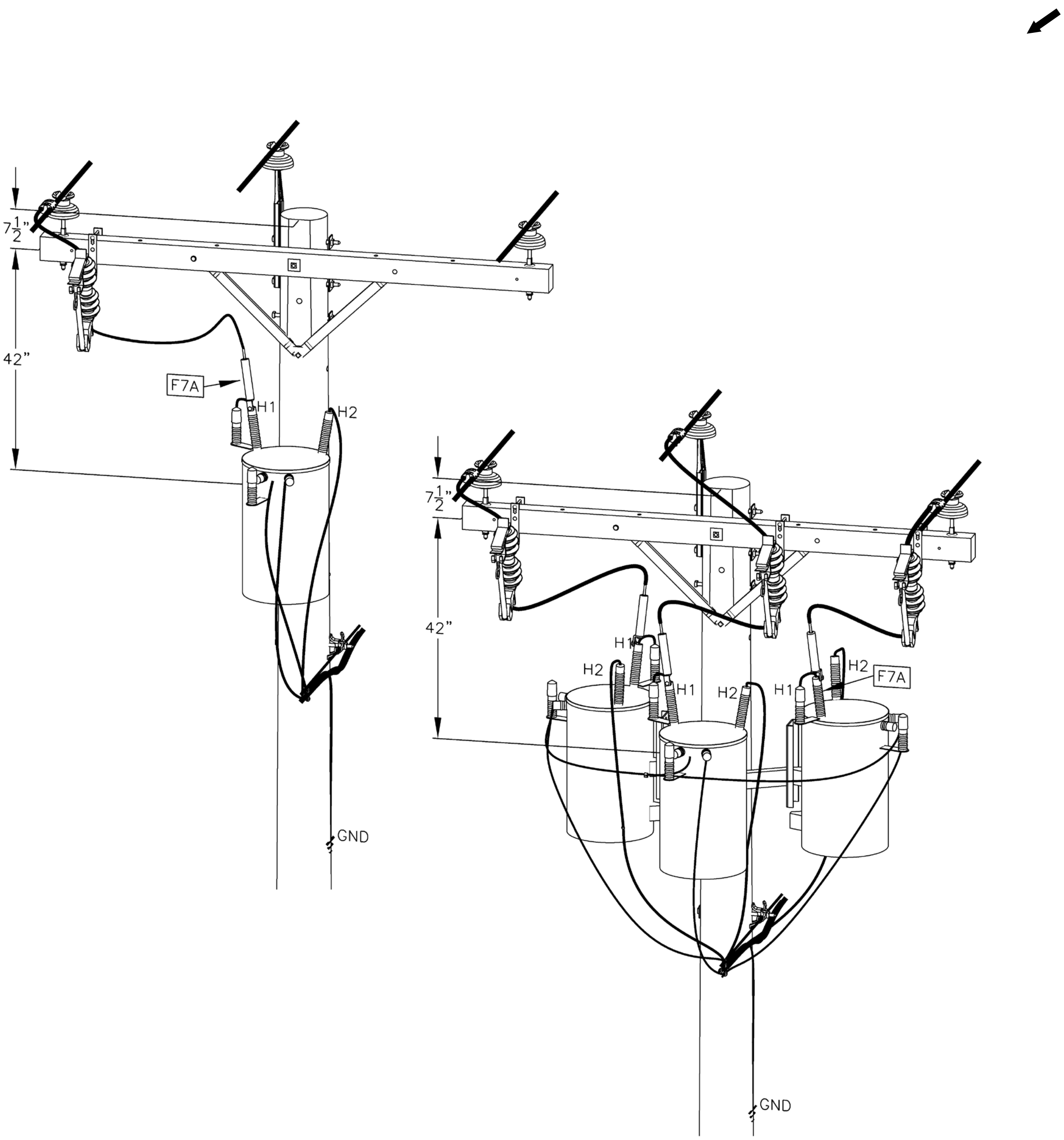
(shaded) Non-standard Company application. If necessary, consult distribution engineering



ANSI TYPE_K FUSE LINK AMPERE RATING (F1K)							
SIZE CSP TRANS.	LOCATION	2.4/4.16 KV		4.8 KV		7.6/13.2 KV	
		REC.	MIN.	REC.	MIN.	REC.	MIN.
5	1	100		100		100	
5	2	65		50		50	
5	3	50		40		40	
5	4	50	40	40	25	40	25
10	1	100		100		100	
10	2	65		50		50	
10	3	65		40		40	
10	4	65	40	40	25	40	25
15	1	100		100		100	
15	2	65		65		50	
15	3	65		50		40	
15	4	65	65	50	40	40	25
25	1	140		100		100	
25	2	100		65		65	
25	3	100		50		50	
25	4	100	100	50	40	40	40
37.5	1	200		140		100	
37.5	2	200		100		65	
37.5	3	200		100		65	
37.5	4	200	140	100	100	65	65
50	1-4	200	200	140	140	140	100
75	1-4	200	200	200	200	140	100
5-75	M	----------STATION BREAKER---------					

If CSP transformers are installed behind minimum size line fuses, there is a calculated risk that a fault in one of the transformers will cause the line fuse to blow.

CU = TFC5	25 A Current Limiting Fuse
CU = TFC7	40 A Current Limiting Fuse



Supersedes 7/17 Issue – Updated Drawing

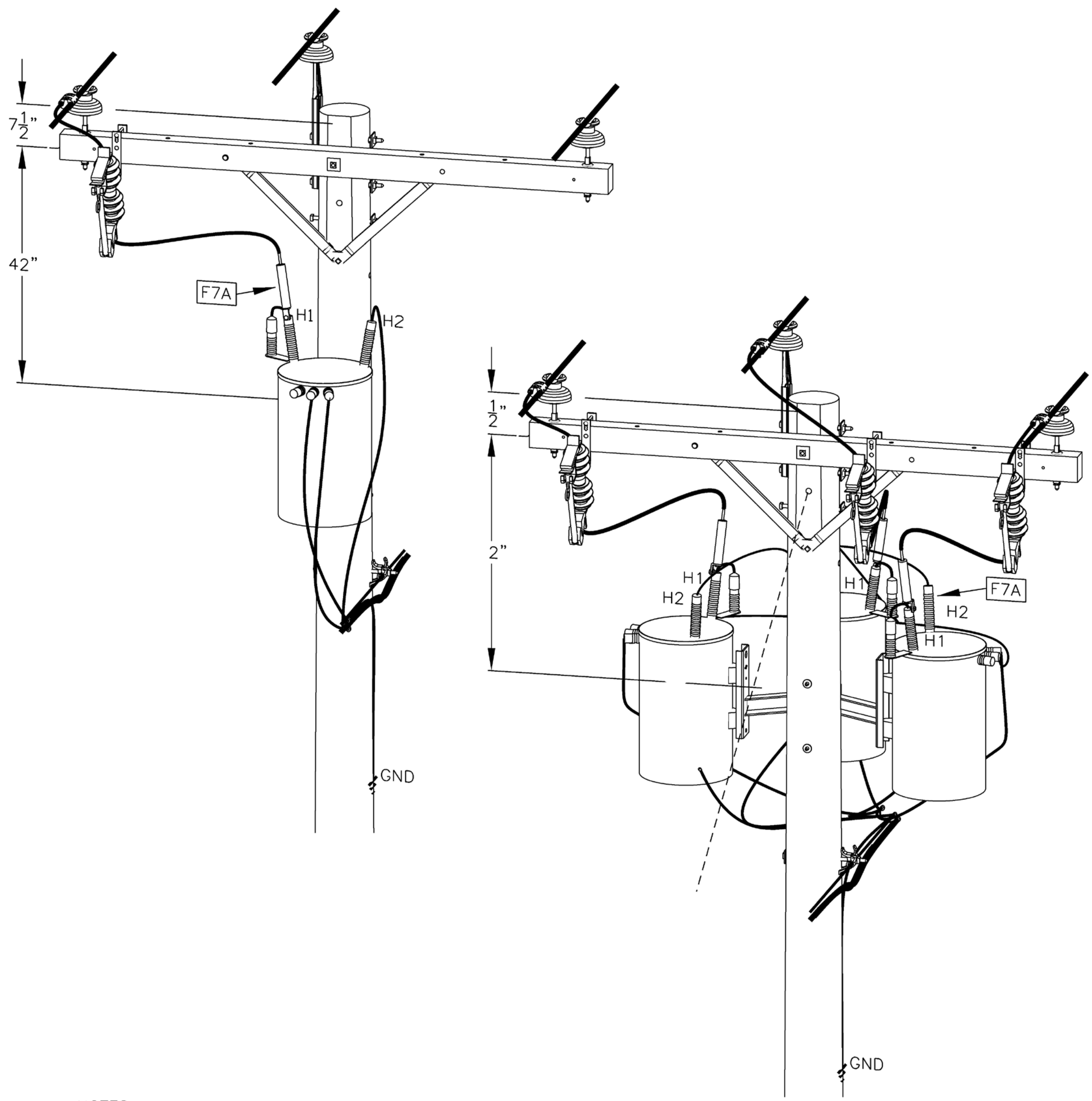
NOTES:

1. THIS CONFIGURATION IS TYPICAL FOR 1Ø OR 3Ø STRAIGHT OR DUAL VOLTAGE CSP TRANSFORMER INSTALLATIONS WHICH HAVE BEEN RETROFITTED WITH FUSED CUTOUTS. ALL STANDARD POLE TOP ARRANGEMENTS ARE APPLICABLE AND CAN BE FITTED IN THE SAME MANNER.
2. SEE SECTION 12.5.20 FOR CL FUSE SELECTION.
3. SEE TRANSFORMER SECTION 14 FOR ADDITIONAL TRANSFORMER INFORMATION.

Designer	Drawing	Date
MPR	od12127	7/3/18

CU = TFC5	25 A Current Limiting Fuse
CU = TFC7	40 A Current Limiting Fuse

Supersedes 7/17 Issue – Updated Drawing

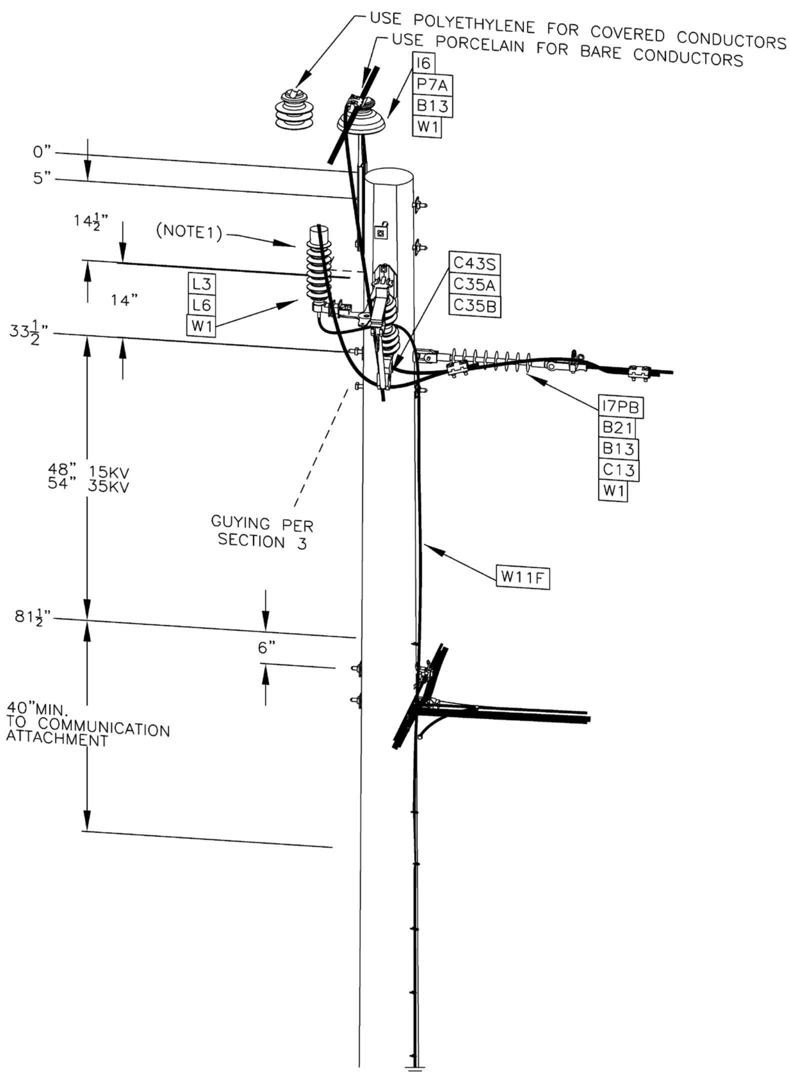


NOTES:
1. THIS CONFIGURATION IS TYPICAL FOR 1Ø OR 3Ø STRAIGHT OR DUAL VOLTAGE CONVENTIONAL TRANSFORMER INSTALLATIONS. ALL STANDARD POLE TOP ARRANGEMENTS ARE APPLICABLE AND CAN BE FITTED IN THE SAME MANNER.
2. SEE SECTION 12.5.20 FOR CL FUSE SELECTION.
3. SEE TRANSFORMER SECTION 14 FOR ADDITIONAL TRANSFORMER INFORMATION.

Designer	Drawing	Date
MPR	od12128	7/3/18

CURRENT LIMITING FUSE INSTALLATION ON CONVENTIONAL TRANSFORMER 15-35KV

CU = CC15K(I)	15 kV Cutout & Fuse Holder, (I) = S1-100 A, S2-200 A, S3S-300 A	CU = CFLK(P)	15 kV Fuse, (P) = Fuse Rating
CU = CC27KS1	27 kV Cutout & Fuse Holder	CU = CFLK35(P)	35 kV Fuse, (P) = Fuse Rating
CU = CAL(X)K	Arrester, Lightning, (X) = Duty Cycle Rating kV	CU = PBCA	Cutout Bracket, Crossarm
CU = PABCA	Bracket for Cutout/Arrester 1 Position		
CU = PABCA3	Bracket for Cutout/Arrester 3 Position		
CU = CSVGLA	Single Vertical Ground for Lightning Arrester		



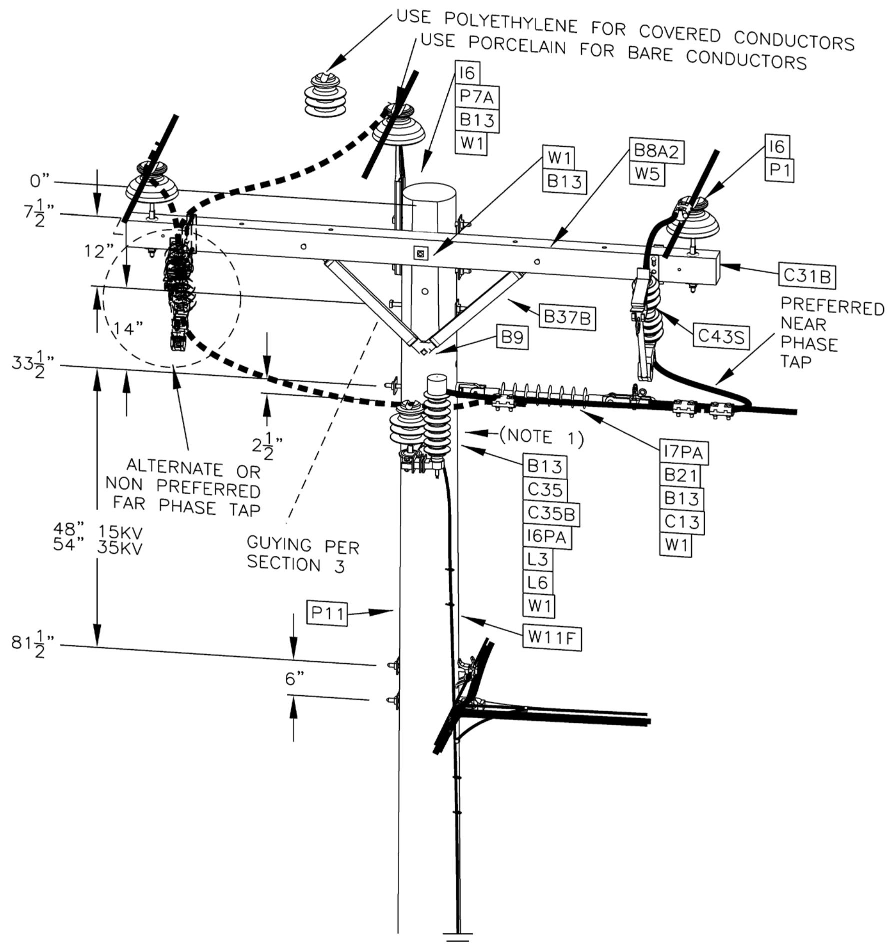
NOTES:
1. SEE OH STANDARDS SECTION 13.6 FOR APPLICATION OF SURGE ARRESTERS.

Designer	Drawing	Date
MPR	od12129	7/3118

Supersedes 7/17 Issue – Updated Drawing

1Φ PRIMARY WITH 1Φ FUSED TAP 15-35 KV

CU = CC15K(I)	15 kV Cutout & Fuse Holder, (I) = S1-100 A, S2-200 A, S3S-300 A	CU = CFLK(P)	15 kV Fuse, (P) = Fuse Rating
CU = CC27KS1	27 kV Cutout & Fuse Holder	CU = CFLK35(P)	35 kV Fuse, (P) = Fuse Rating
CU = CAL(X)K	Arrester, Lightning, (X) = Duty Cycle Rating kV	CU = PBCA	Cutout Bracket, Crossarm
CU = PABCA	Bracket for Cutout/Arrester 1 Position		
CU = PABCA3	Bracket for Cutout/Arrester 3 Position		
CU = CSVGLA	Single Vertical Ground for Lightning Arrester		



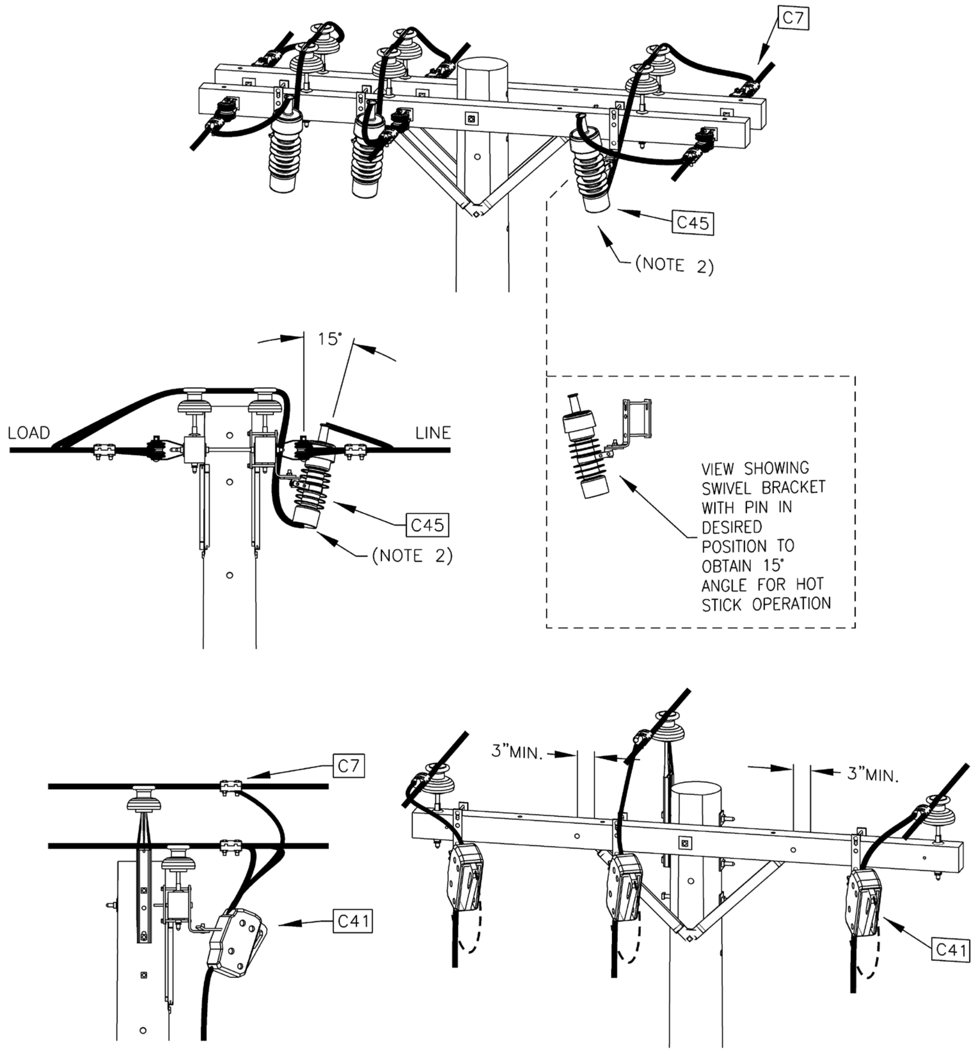
NOTES:
1. SEE OH STANDARDS SECTION 13.6 FOR APPLICATION OF SURGE ARRESTERS.
2. CAN USE 3 POSITION BRACKET (C35A) INSTEAD OF CUTOUT ON ARM.

Designer	Drawing	Date
MPR	od12130	7/3/18

Supersedes 7/17Issue – Updated Drawing

3Φ PRIMARY WITH 1Φ FUSED TAP 15-35 KV

CU = CC5K**L**	5 kV Cutout, **L** = Cutout Box Size
CU = CFLK**P**	Fuse Size, **P** = Fuse Rating



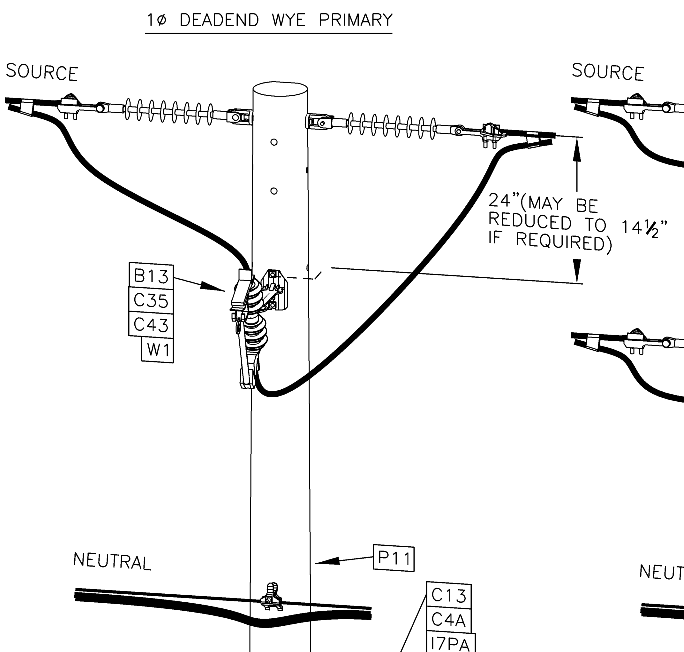
INFORMATION ONLY – USE OPEN-TYPE CUTOUTS

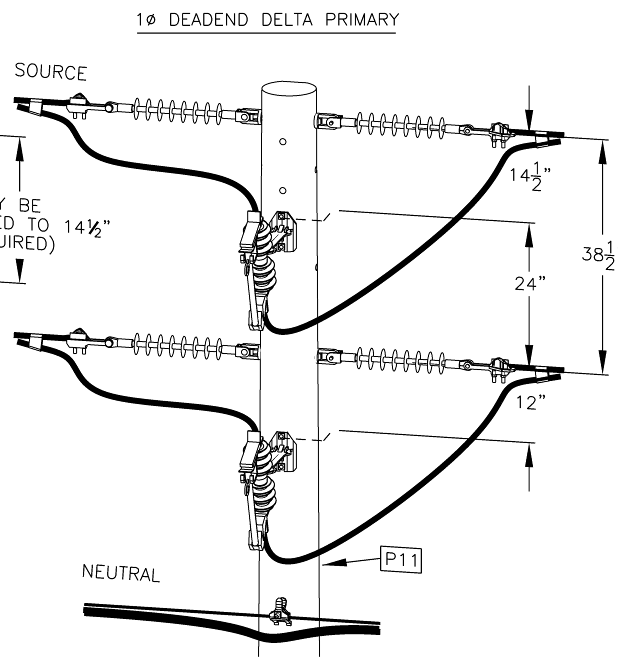
NOTES:
1. THE LOCATION OF ALL DISCONNECTING DEVICES MUST BE CHOSEN TO MINIMIZE POSSIBILITY OF AN ARC FLARING UP INTO, OR BEING BLOWN INTO OTHER CIRCUITS.
2. CONDUCTORS INSERTED INTO THE TERMINALS OF CUTOUTS AND DISCONNECTS SHALL BE COPPER.

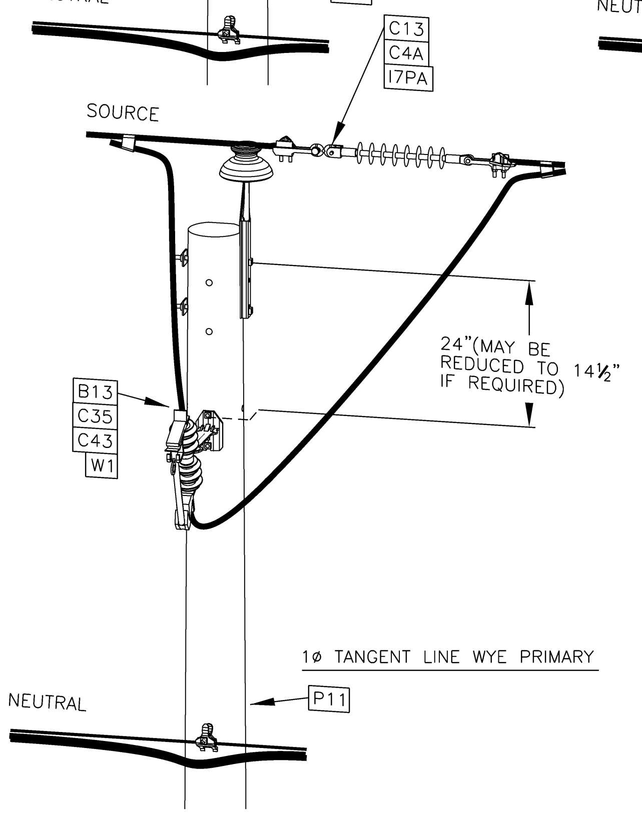
Designer	Drawing	Date
MPR	od12131	7/3/18

Supersedes 1/06 Issue – Updated Drawing to 3D

MU = @C15KCO**P**	15 kV Cutout, **P** = Fuse Rating
MU = @C35KCO**P**	27 kV Cutout, **P** = Fuse Rating







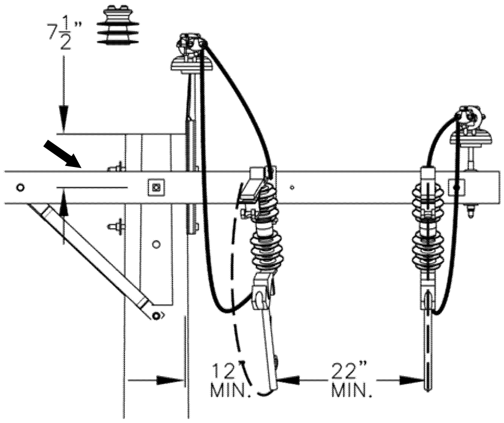
NOTE:
1. SEE OH STANDARDS SECTION 13.6 FOR APPLICATION OF SURGE ARRESTERS.

Designer	Drawing	Date
MPR	od12132	1/31/20

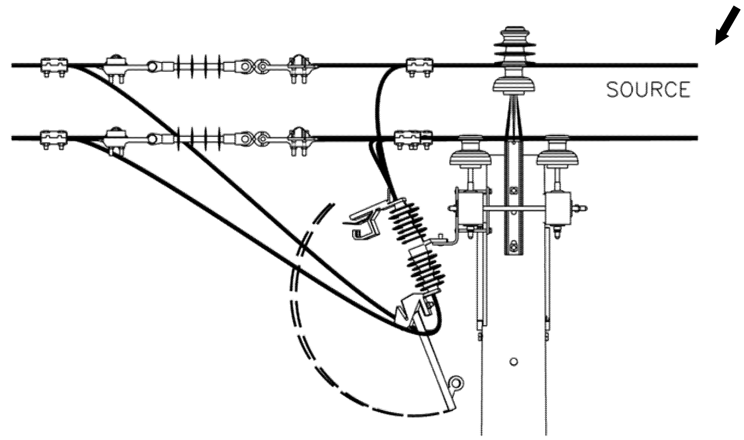
Supersedes 7/19 Issue –Updated drawing.

1Φ PRIMARY SECTIONALIZING 15-35 KV

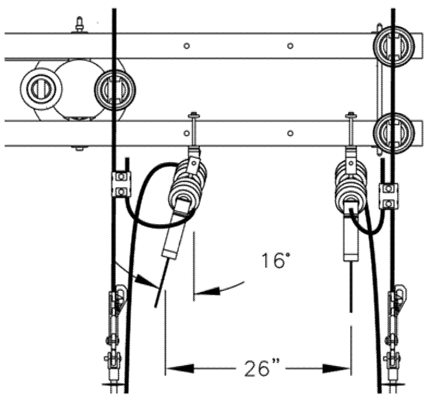
MU = @C3COTL(I)K	15 kV 3 Phase Tangent Line, (I) = CO Body Size: S1-100, S2-200 K Link
MU = @C3COTL35K(I)K	27 kV 3 Phase Tangent Line, (I) = CO Body Size 35 kV: S41-100



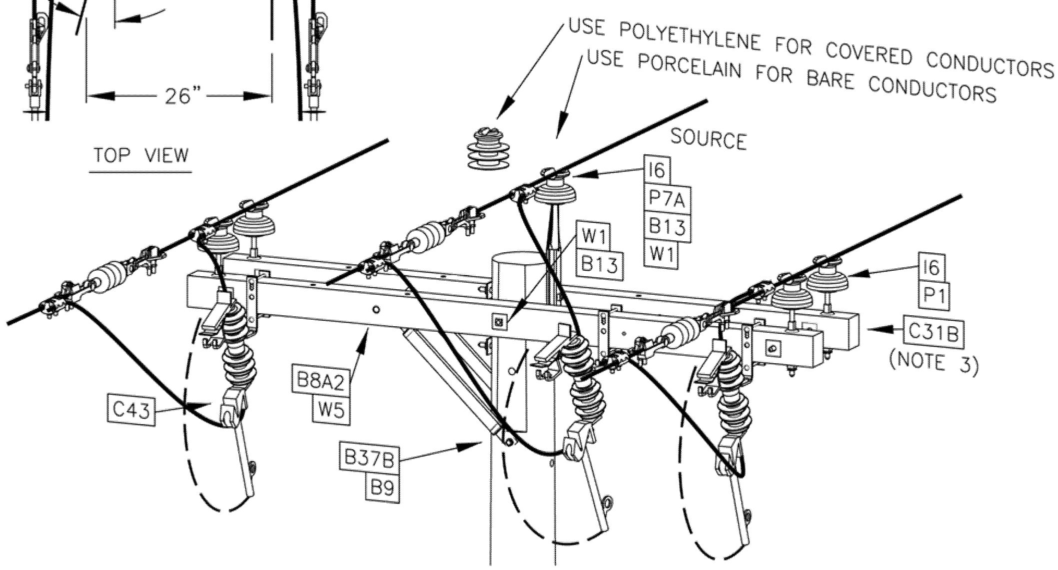
FRONT VIEW



SIDE VIEW



TOP VIEW



TANGENT LINE AND ANGLES 0° TO 20°

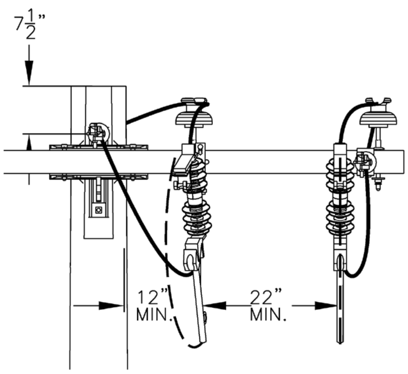
NOTES:

1. COVERED–WIRE TAPS MAY REQUIRE STRIPPING TO PROVIDE 6" BARE WIRE FOR OPERATIONAL GROUNDING NEAR THE CUTOUT TERMINALS.
2. USE DOUBLE PINS AND INSULATORS ON ARM FOR ANGLES 11°TO 20° AND PUT CONDUCTOR IN SIDE GROOVE.
3. USE ITEM C31B (8FT CROSSARM) WITH B37B BRACE FOR 15KV CONSTRUCTION AND ITEM TC10 (10FT CROSSARM) WITH TB60 BRACE FOR 35KV CONSTRUCTION.
4. SEE OH STANDARDS SECTION 13.6 FOR APPLICATION OF SURGE ARRESTERS.

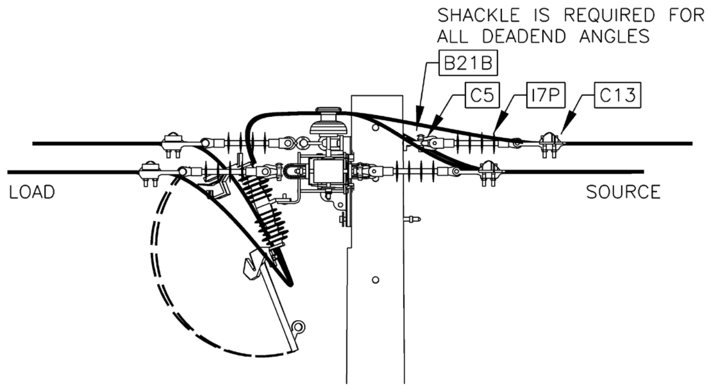
Designer	Drawing	Date
MPR	od12133A	3/15/19

Supersedes 7/18 Issue – Added note 4 to drawing

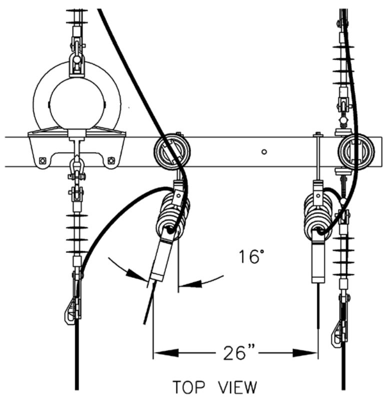
MU = @C3CODE(I)K	15 kV 3 Phase Deadend, (I) = CO Body Size: S1-100, S2-200 K Link
MU = @C3CODE35K(I)K	27 kV 3 Phase Deadend, (I) = CO Body Size 35 kV: S41-100



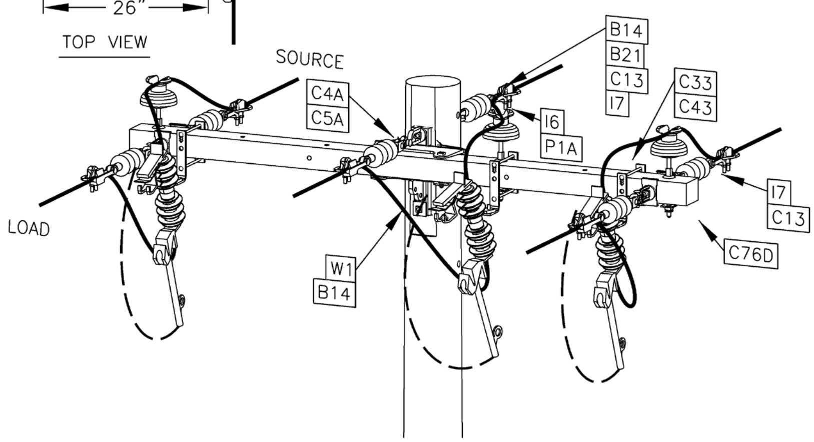
FRONT VIEW



SIDE VIEW



TOP VIEW



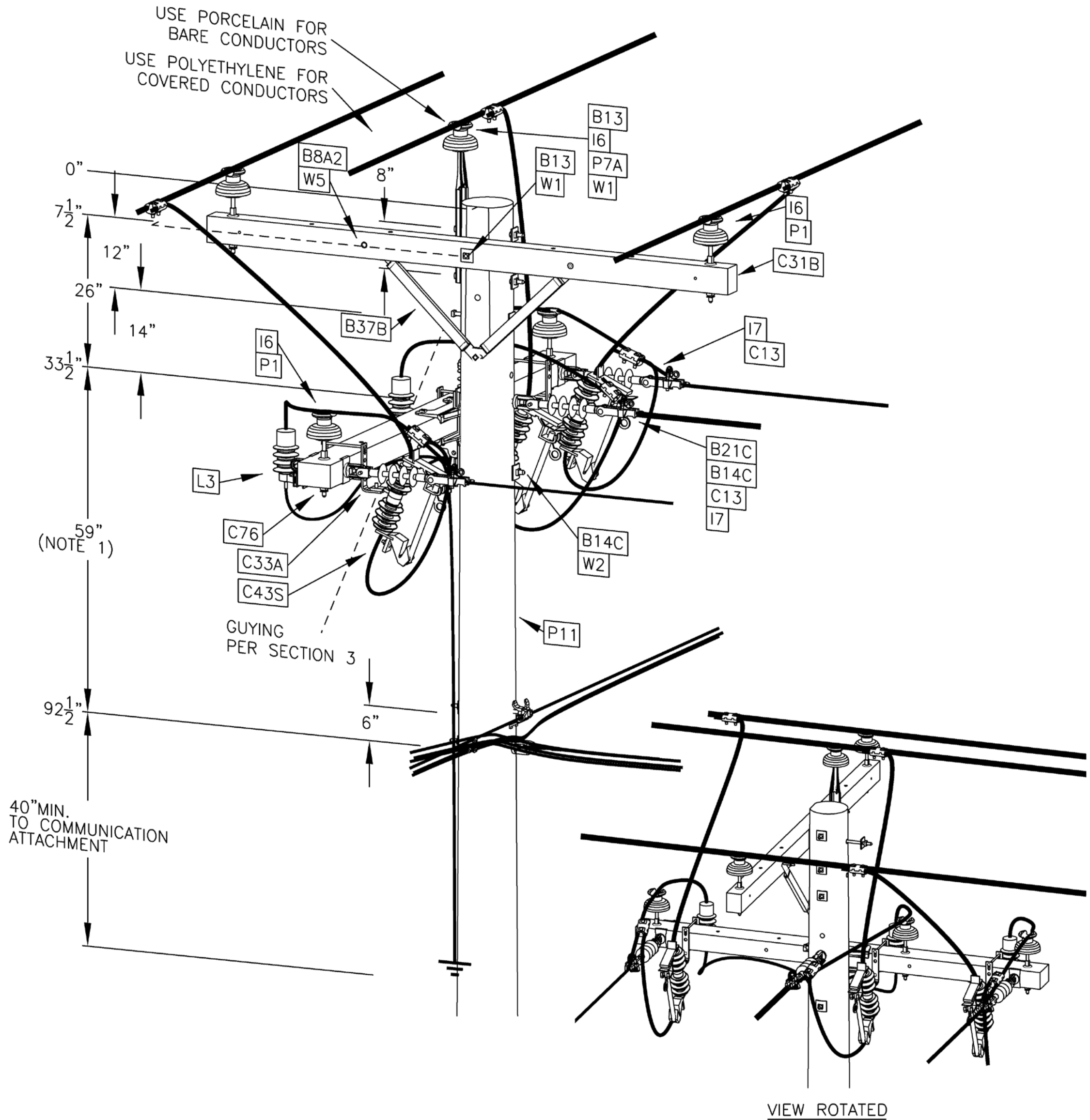
DEADENDS AND ANGLES 21° TO 60°

Supersedes 7/19 Issue – Added material IDs.

NOTES:
1. COVERED-WIRE TAPS MAY REQUIRE STRIPPING TO PROVIDE 6" BARE WIRE FOR OPERATIONAL GROUNDING NEAR THE CUTOUT TERMINALS.
2. USE DOUBLE PINS AND INSULATORS ON ARM FOR ANGLES 11°TO 20° AND PUT CONDUCTOR IN SIDE GROOVE.
3. USE ITEM TC10 (10FT CROSSARM) WITH TB60 BRACE FOR 35KV CONSTRUCTION.
4. SEE OH STANDARDS SECTION 13.6 FOR APPLICATION OF SURGE ARRESTERS.

Designer	Drawing	Date
MPR	od12133B	1/15/21

3 Φ PRIMARY SECTIONALIZING 15-35 KV LINE ANGLES 0˚-20˚



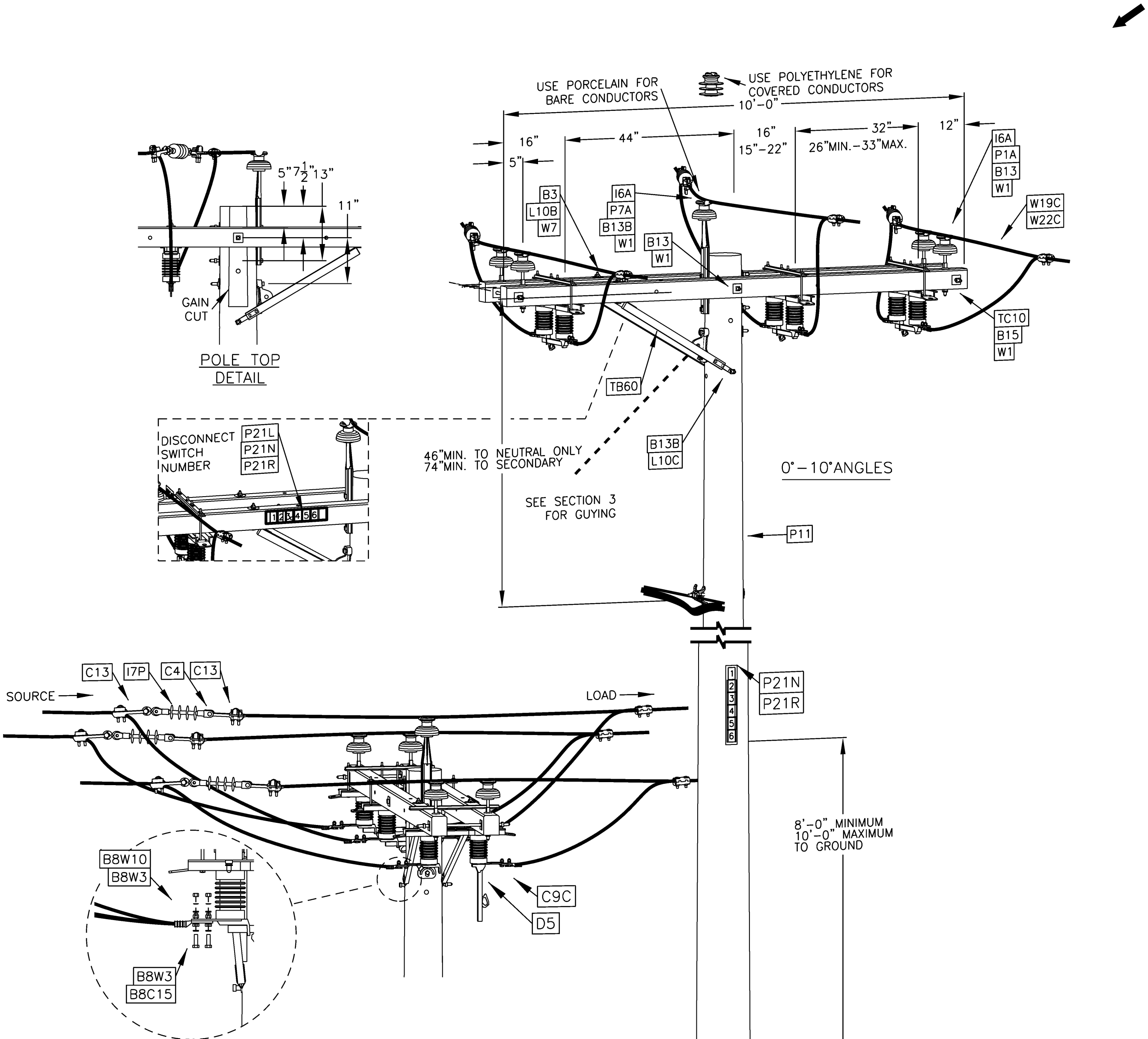
Supersedes 7/17 Issue – Updated Drawing

NOTES:
1. FIBERGLASS CROSS ARM TO MEET THE REQUIREMENTS OF SECTION 4 – STORM HARDENING.

Designer	Drawing	Date
MPR	od12134	7/3/18

MU = @12-13510D15K	15 kV 3 phase Disconnect 0°-10°
MU = @12-13510D35K	35 kV 3 phase Disconnect 0°-10°

Supersedes 7/18 Issue – Updated Drawing



NOTES:

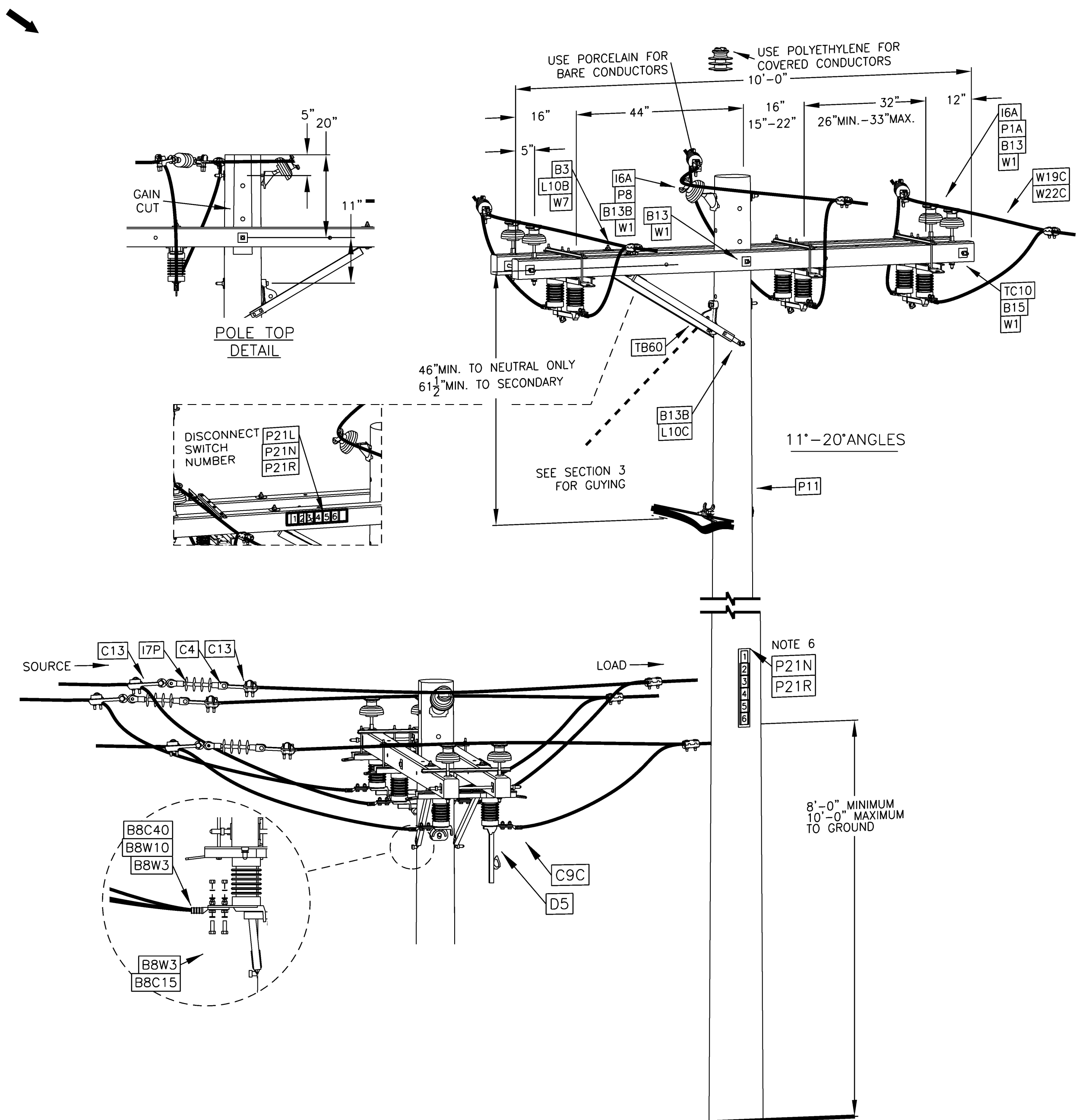
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SEE TABLE 2 FOR DISCONNECT RATINGS. STANDARD PRACTICE IS TO INSTALL SWITCH SO THAT THE BLADE OPENS AWAY FROM THE SOURCE AND IS DE-ENERGIZED WHEN OPEN.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. SEE DRAWINGS 12-139 AND 12-140 FOR SWITCH INSTALLATIONS ON SEPARATE SWITCH ARMS.
6. DISCONNECT SWITCH NUMBER MOUNTED VERTICALLY FACING TOWARD ONCOMING TRAFFIC PROVIDING MAXIMUM VISIBILITY.
7. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od12135A	6/30/20

UNDERSLUNG DISCONNECT SWITCH TANGENT LINE ANGLES 0˚-10˚ 15-35 KV

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	12-135A	7/20

MU = @12-1351120D15K	15 kV 3 phase Disconnect 11°-20°
MU = @12-1351120D35K	35 kV 3 phase Disconnect 11°-20°



Supersedes 7/18 Issue – Updated Drawing

NOTES:

1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SEE TABLE 2 FOR DISCONNECT RATINGS. STANDARD PRACTICE IS TO INSTALL SWITCH SO THAT THE BLADE OPENS AWAY FROM THE SOURCE AND IS DE- ENERGIZED WHEN OPEN.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. SEE DRAWINGS 12–139 AND 12–140 FOR SWITCH INSTALLATIONS ON SEPARATE SWITCH ARMS.
6. SWITCH IDENTIFICATION NUMBER MOUNTED VERTICALLY FACING TOWARD TRAFFIC PROVIDING MAXIMUM VISIBILITY.
7. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

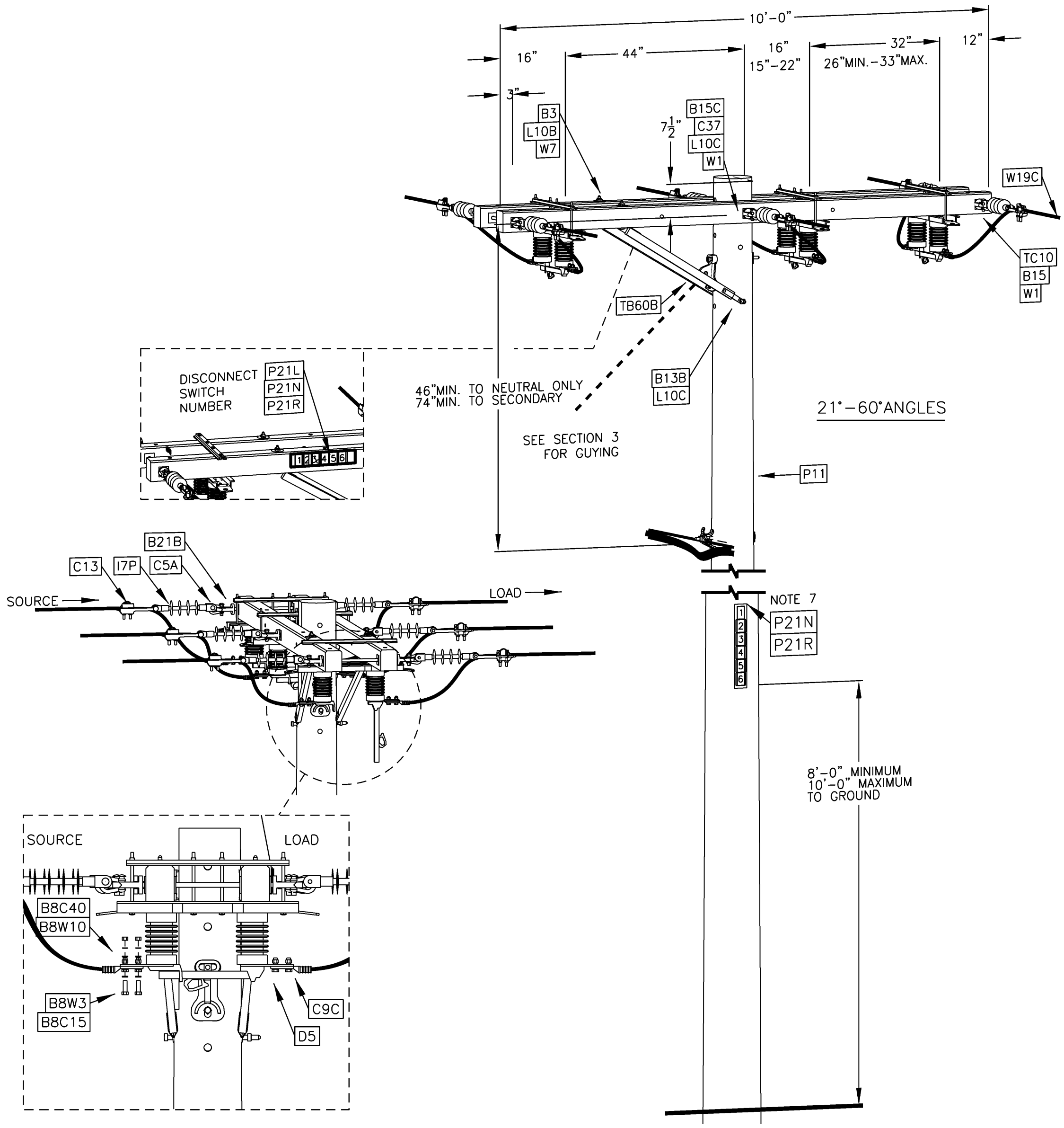
Designer	Drawing	Date
MPR	od12135B	6/30/20

UNDERSLUNG DISCONNECT SWITCH TANGENT LINE ANGLES 11˚-20˚ 15-35 KV

ISSUE	PAGE NUMBER		
7/20	12-135B	OVERHEAD CONSTRUCTION STANDARD	ppl

MU = @12-1362160D15K	15 kV 3 Phase Disconnect
MU = @12-1362160D35K	35 kV 3 Phase Disconnect

Supersedes 7/18 Issue – Updated Drawing

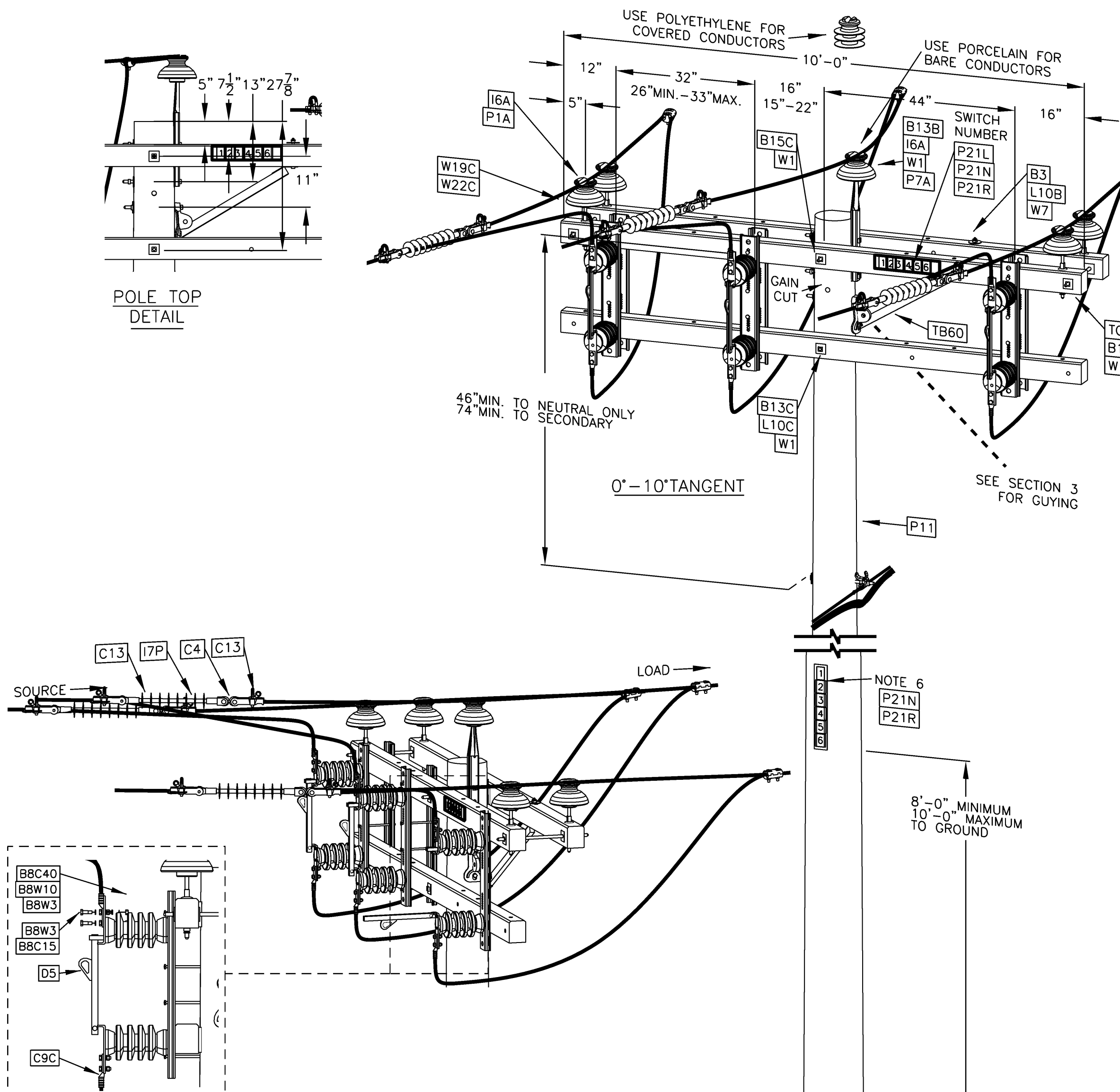


NOTES:
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SEE TABLE 2 FOR DISCONNECT RATINGS. STANDARD PRACTICE IS TO INSTALL SWITCH SO THAT THE BLADE OPENS AWAY FROM THE SOURCE AND IS DE ENERGIZED WHEN OPEN.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. SEE DRAWINGS 12-139 AND 12-140 FOR SWITCH INSTALLATIONS ON SEPARATE SWITCH ARMS.
6. SEE DRAWING 12-135 FOR CONDUCTORS ON PINS AND ANGLES 0° TO 20°.
7. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TOWARD TRAFFIC PROVIDING MAXIMUM VISIBILITY.
8. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od12136	6/30/20

UNDERSLUNG DISCONNECT SWITCH 3Φ LINE ANGLES 21˚-60˚ - CROSSARM DEADEND 15 KV

MU = @DISWCH15K	15 kV 3 Phase Disconnect Vertical



NOTES:
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SEE TABLE 2 FOR DISCONNECT RATINGS. STANDARD PRACTICE IS TO INSTALL SWITCH SO THAT THE BLADE OPENS AWAY FROM THE SOURCE AND IS DE-ENERGIZED WHEN OPEN.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. SEE DRAWINGS 12-139 AND 12-140 FOR SWITCH INSTALLATIONS ON SEPARATE SWITCH ARMS.
6. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TOWARD TRAFFIC PROVIDING MAXIMUM VISIBILITY.
7. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od12137A	6/30/20

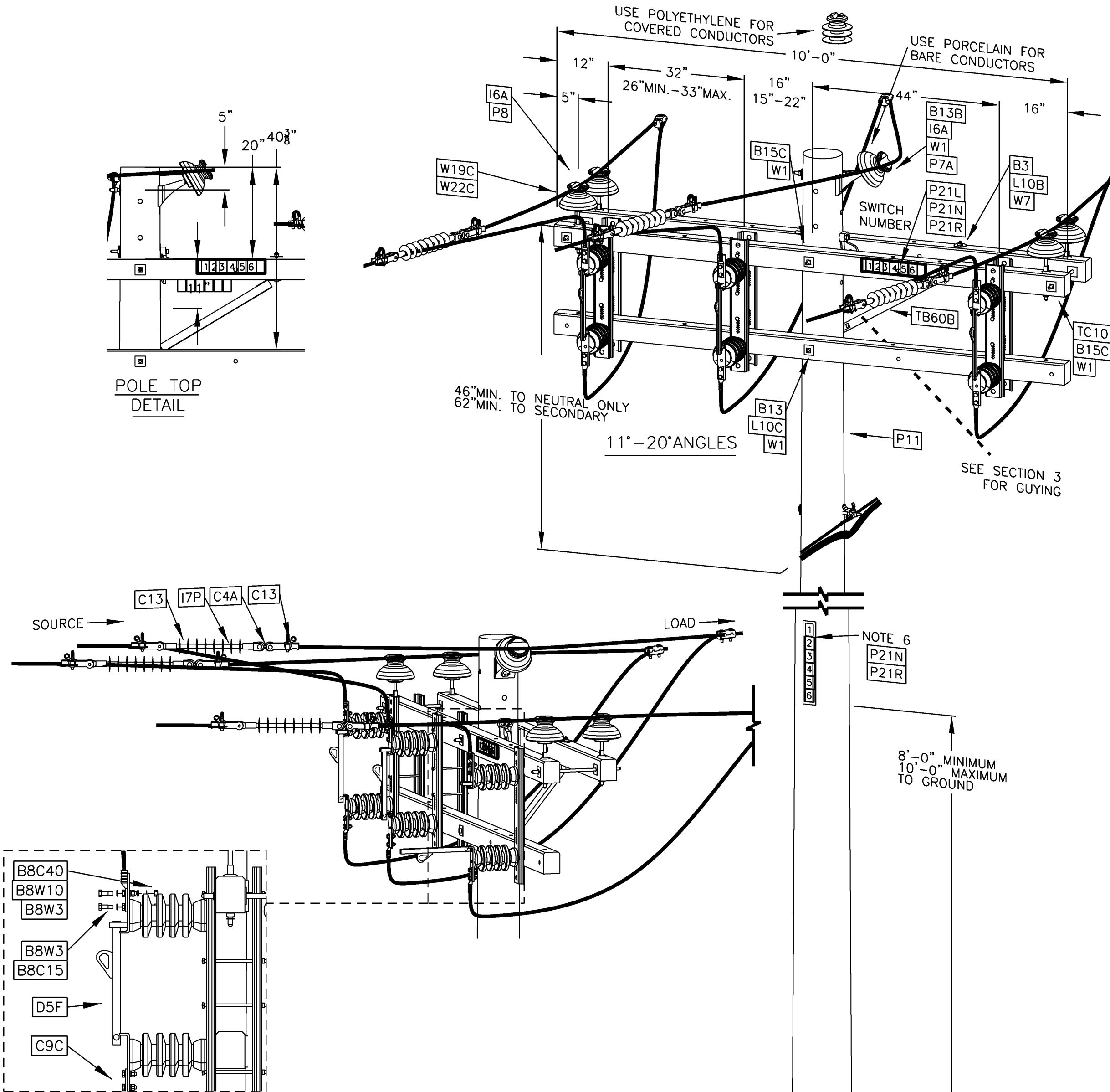
Supersedes 7/18 Issue – Updated Drawing

UNDERSLUNG DISCONNECT SWITCH TANGENT LINE ANGLES 0˚-10˚ 15-35 KV

ISSUE	PAGE NUMBER		
7/20	12-137A	OVERHEAD CONSTRUCTION STANDARD	ppl

CU = CDS15KIL	15 kV In-Line Switch (1)

Supersedes 7/18 Issue – Updated Drawing



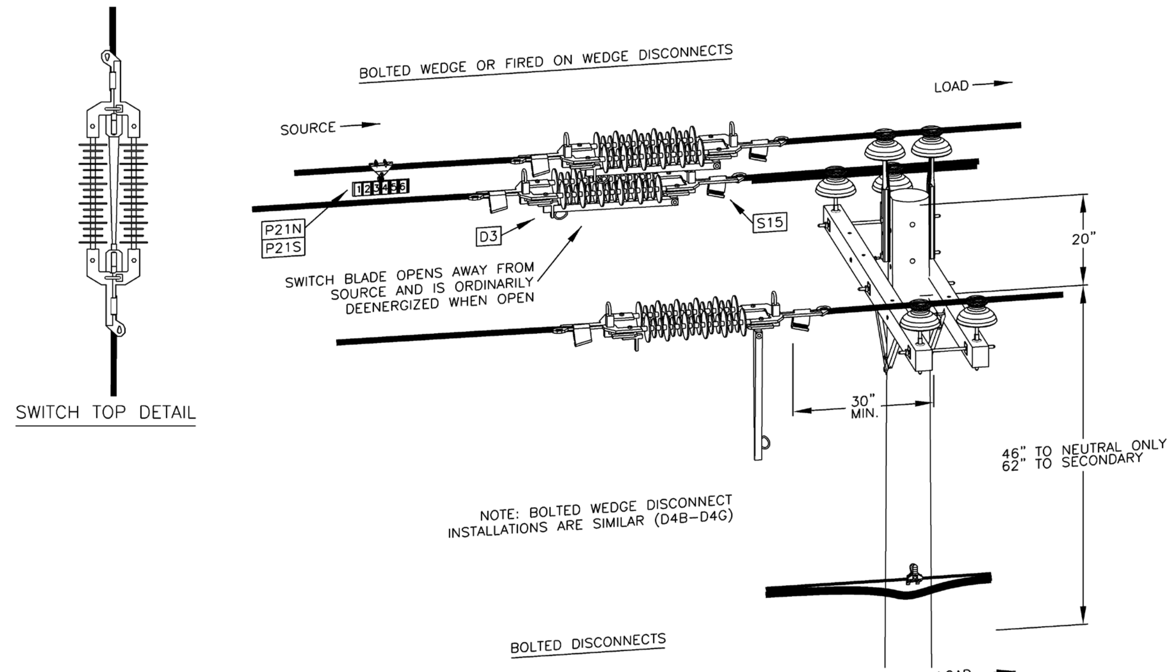
NOTES:

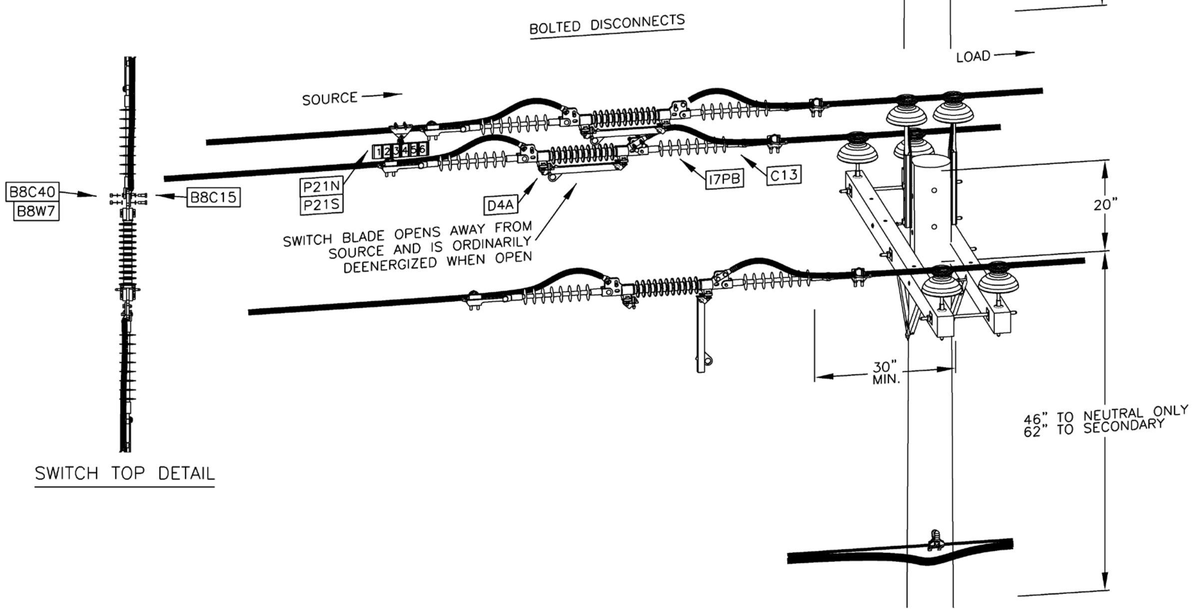
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SEE TABLE 2 FOR DISCONNECT RATINGS. STANDARD PRACTICE IS TO INSTALL SWITCH SO THAT THE BLADE OPENS AWAY FROM THE SOURCE AND IS DE-ENERGIZED WHEN OPEN.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. SEE DRAWINGS 12-139 AND 12-140 FOR SWITCH INSTALLATIONS ON SEPARATE SWITCH ARMS.
6. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TOWARD TRAFFIC PROVIDING MAXIMUM VISIBILITY.
7. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od12137B	6/30/20

UNDERSLUNG DISCONNECT SWITCH TANGENT LINE ANGLES 11˚-20˚ 15-35 KV

CU = CDS(X)K(Y)AIL	Fired-On Wedge In-Line Switch, (X) = Nominal Voltage, (Y) = Wire Size
CU = CDS(X)K(Y)IL	Bolted In-Line Switch, (X) = Nominal Voltage, (Y) = Wire Size





Supersedes 7/07 Issue – Added Switch Identifier hanger as an option. Added note 7.

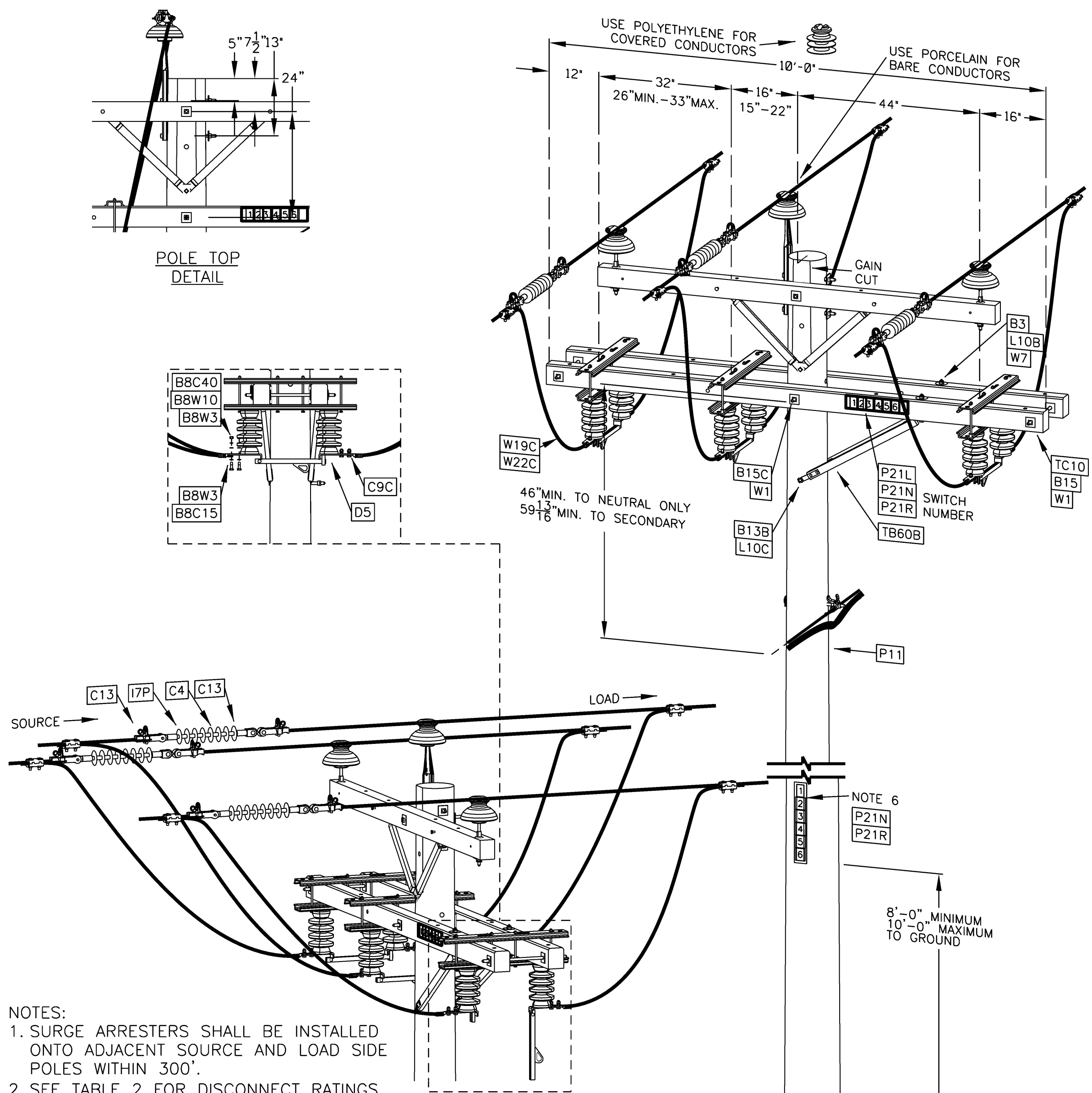
NOTES:

1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. USE THE IN-LINE SWITCH ARRANGEMENT ONLY WHEN CLEARANCES WILL NOT ALLOW SWITCH INSTALLATIONS ON CROSSARMS (SEE DRAWINGS 12-135, 136, 137, 139 AND 140).
3. THIS ARRANGEMENT MAY BE APPLIED TO OTHER TYPES OF OPEN TYPES OF OPEN WIRE POLE TOPS INCLUDING RECLOSER INSTALLATIONS.
4. FOR POLE TOP CONFIGURATIONS, DOUBLE INSULATOR TIE POINTS ARE REQUIRED TO REDUCE THE STRAIN UNDER SWITCH OPERATION.
5. SWITCH IDENTIFICATION SHALL BE INSTALLED ON THE CONDUCTOR MIDDLE PHASE USING THE P21S HANGER.
6. DO NOT INSTALL IN LINE SWITCHES ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20 DEGREES.
7. THE PREFERRED BOLTED SWITCH IS THE BOLTED WEDGE STYLE SWITCH (STD ITEMS D4B-D4G). USE THE D4A SWITCH FOR COPPER CONDUCTORS OR CONDUCTOR SIZES THAT ARE OUTSIDE THE RANGE OF D4B-D4G.
8. SEE OH STANDARDS SECTION 13.6 FOR APPLICATION OF SURGE ARRESTERS.

Designer	Drawing	Date
MPR	od12138	1/31/20

MU = @12-13910D15K	15 kV 3 Phase Disconnect Underslung
MU = @12-13910D35K	35 kV 3 Phase Disconnect Underslung

Supersedes 7/18 Issue – Updated Drawing



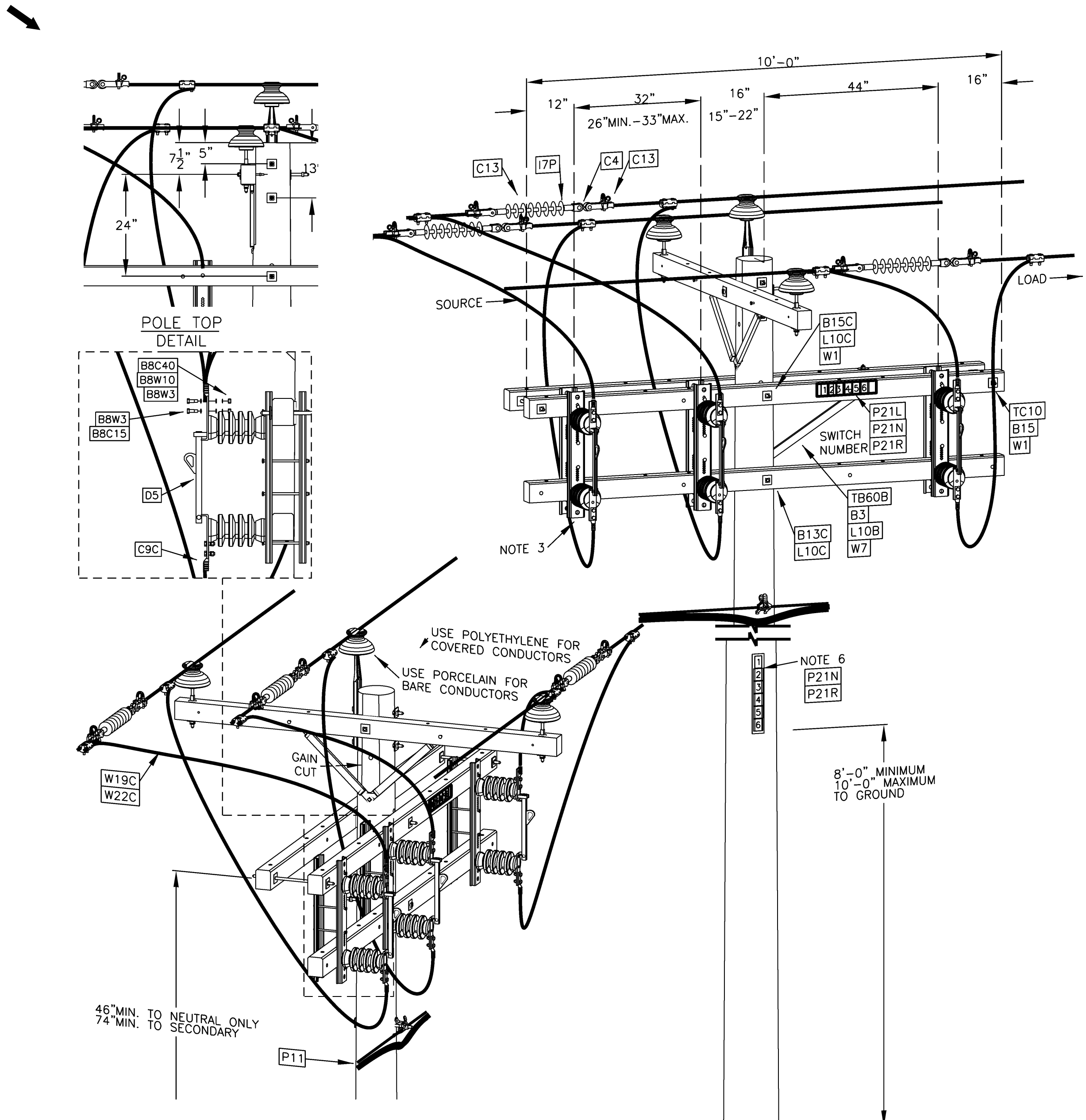
NOTES:

1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SEE TABLE 2 FOR DISCONNECT RATINGS. STANDARD PRACTICE IS TO INSTALL SWITCH SO THAT THE BLADE OPENS AWAY FROM THE SOURCE AND IS DE- ENERGIZED WHEN OPEN.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. THIS ARRANGEMENT IS AN ALTERNATE TO DRAWING 12-135, 0°-10°ANGLE DRAWING SHOWN. SEE DRAWING 12-140 FOR VERTICAL DISCONNECTS ON SWITCHARMS. (DISCONNECTS INSTALLED DIRECTLY TO THE DOUBLE 10' PRIMARY CROSSARMS)
6. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TOWARD TRAFFIC PROVIDING MAXIMUM VISIBILITY.
7. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od12139	6/30/20

UNDERSLUNG DISCONNECT SWITCHES – ON SWITCHARMS 15-35 KV

MU = @12-14010D15K	15 kV 3 Phase Disconnect Vertical
MU = @12-14010D35K	35 kV 3 Phase Disconnect Vertical



NOTES:

1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SEE TABLE 2 FOR DISCONNECT RATINGS. STANDARD PRACTICE IS TO INSTALL SWITCH SO THAT THE BLADE OPENS AWAY FROM THE SOURCE AND IS DE- ENERGIZED WHEN OPEN.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. THIS ARRANGEMENT IS AN ALTERNATE TO DRAWING 12-137, 0°-10°ANGLE DRAWING SHOWN. SEE DRAWING 12-139 FOR HORIZONTAL UNDERHUNG DISCONNECTS ON SWITCH ARMS. SWITCH ARMS ARE ORIENTED PARALLEL TO POLE LINE FOR OPERATOR ACCESSABILITY.(DISCONNECTS INSTALLED DIRECTLY TO THE DOUBLE 10' PRIMARY CROSS ARMS)
6. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TRAFFIC PROVIDING MAXIMUM VISIBILITY.
7. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

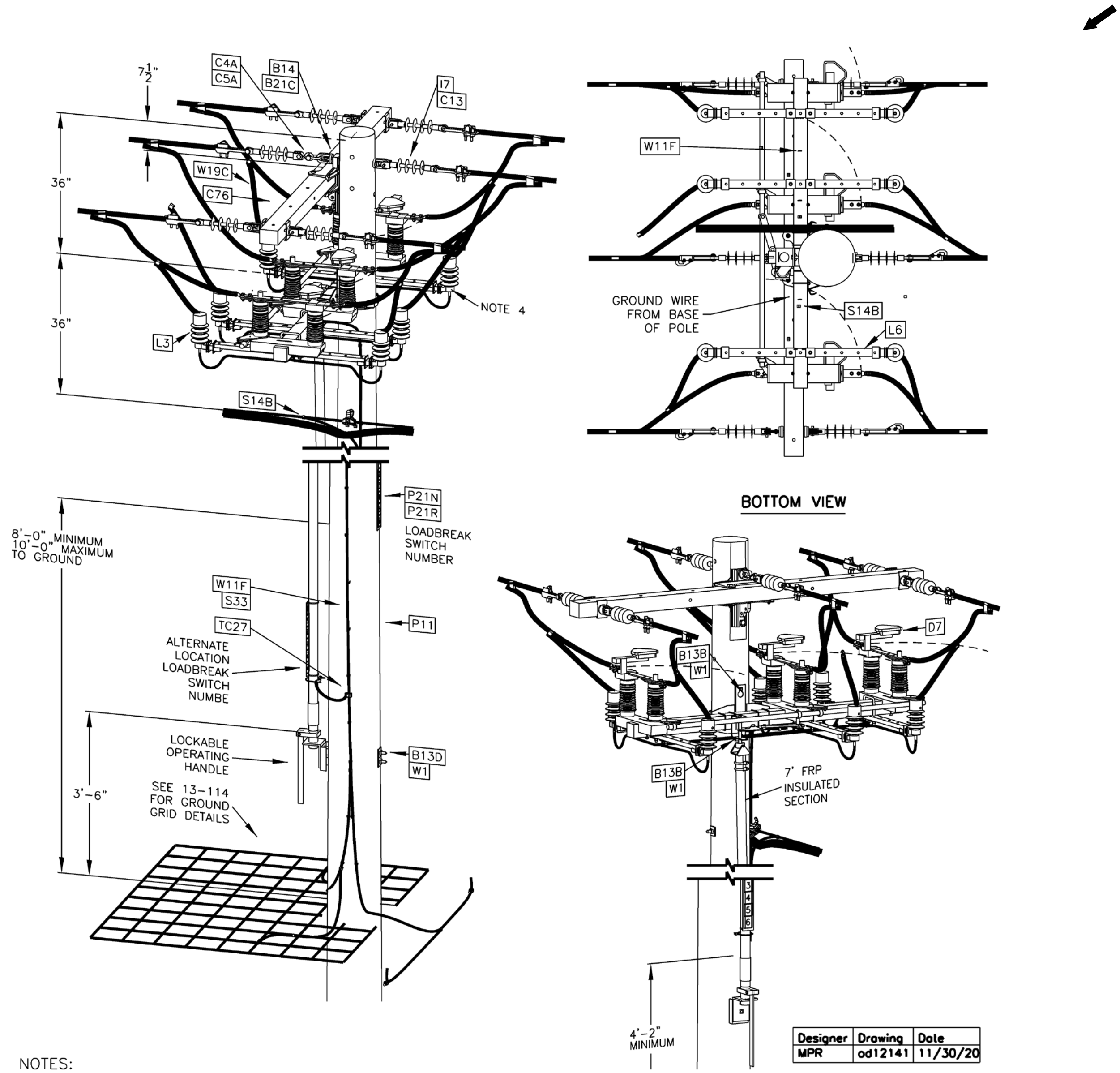
Designer	Drawing	Date
MPR	od12140	6/30/20

Supersedes 7/18 Issue – Updated Drawing

VERTICAL DISCONNECT SWITCHES – ON SWITCHARMS 15-35 KV

MU = @12-141LBSW15KVWXA	15 kV 3 Phase Loadbreak Switch)
MU = @12-141LBSW35KVWXA	35 kV 3 Phase Loadbreak Switch

Supersedes 7/20 Issue – Updated material IDs.



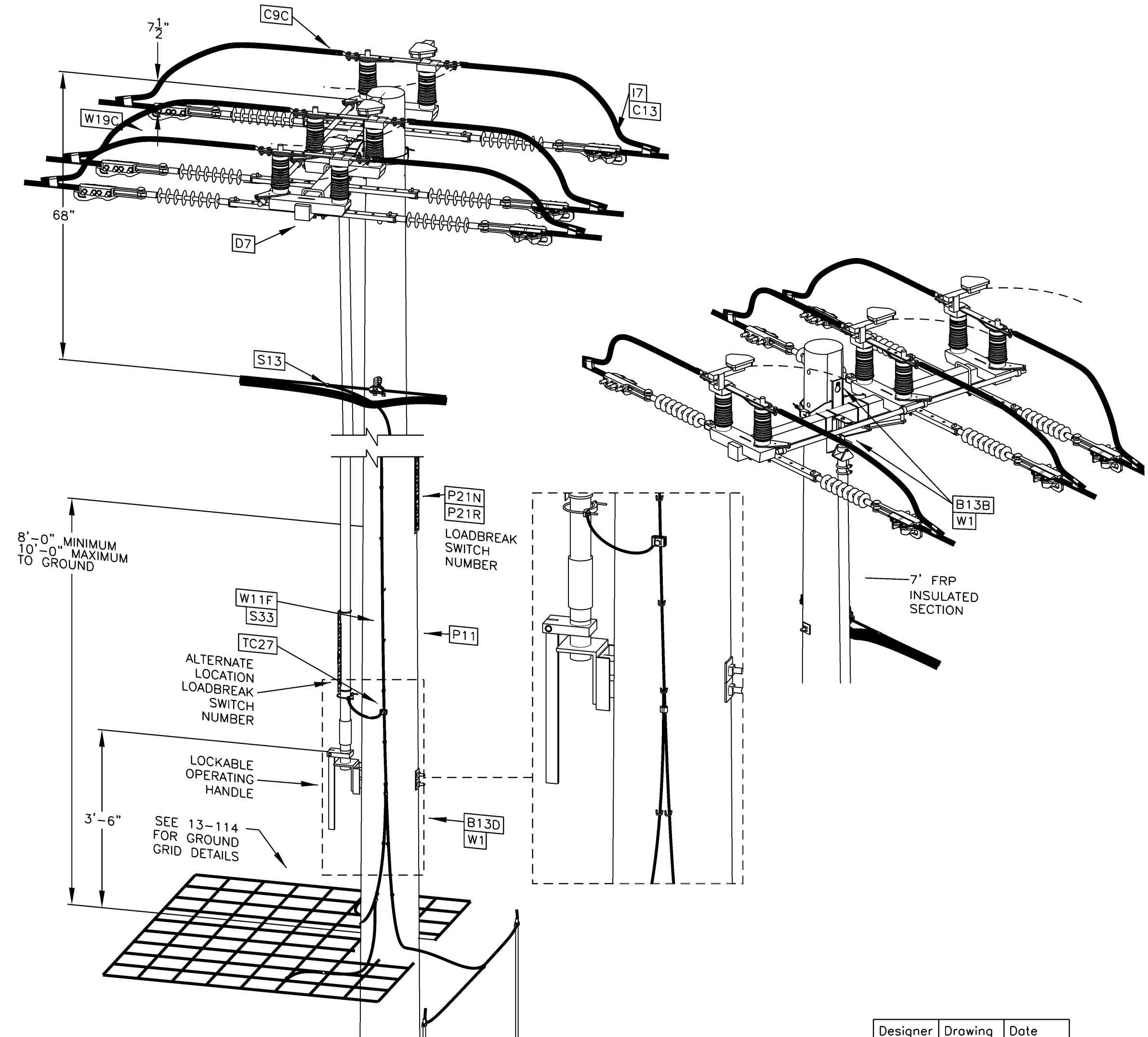
Designer	Drawing	Date
MPR	od12141	11/30/20

NOTES:
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO THE LOAD BREAK ARRESTOR PROVISIONS PROVIDED OR ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'. (ARRESTERS MUST BE INSTALLED VERTICALLY AS SHOWN)
2. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
3. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
4. PRIMARY CONDUCTORS SHALL NEVER BE INSTALLED TO ONLY ONE SIDE OF THE SWITCH AS MAXIMUM DEADEND LOADING WILL BE EXCEEDED.
5. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°. 0° TO 10°ANGLE DRAWING IS SHOWN.
6. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
7. OPERATING MECHANISM SHALL BE LOCKED IN THE OPEN OR CLOSED POSITION.
8. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TRAFFIC PROVIDING MAXIMUM VISIBILITY.
9. ALL LOAD BREAKS TO BE INSTALLED ON A H1 CLASS POLE AND DOUBLE DEAD ENDED ON A FIBERGLASS CROSS ARM PER SECTION 4 – STORM HARDENING.
10. USE UC5G(500KCMIL CU TAP WIRE) WITH D7G(35KV 1200AMP LOADBREAK). UC5G CAN BE FOUND IN THE UG STANDARDS BOOK.
11. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

MU = @12-142LBSW15KV	15 kV 3 Ph LB Sw	MU = @12-142LBSWUNK15KV	35 kV 3 Ph LB Sw Unk Deg.
MU = @12-142LBSW1120D15KV	15 kV 3 Ph LB Sw 11-20 Deg.		
MU = @12-142LBSW1120D15KV	15 kV 3 Ph LB Sw 11-20 Deg.	MU = @12-142LBSWUNK35KV	35 kV 3 Ph LB Sw Unk Deg.

Supersedes 7/18 Issue – Updated Drawing.

MU = @12-143LBSW15KVWCO	15 kV 3 Phase Loadbreak Switch, Plus Cutout MUs
MU = @12-143LBSW35KVWCO	35 kV 3 Phase Loadbreak Switch, Plus Cutout MUs



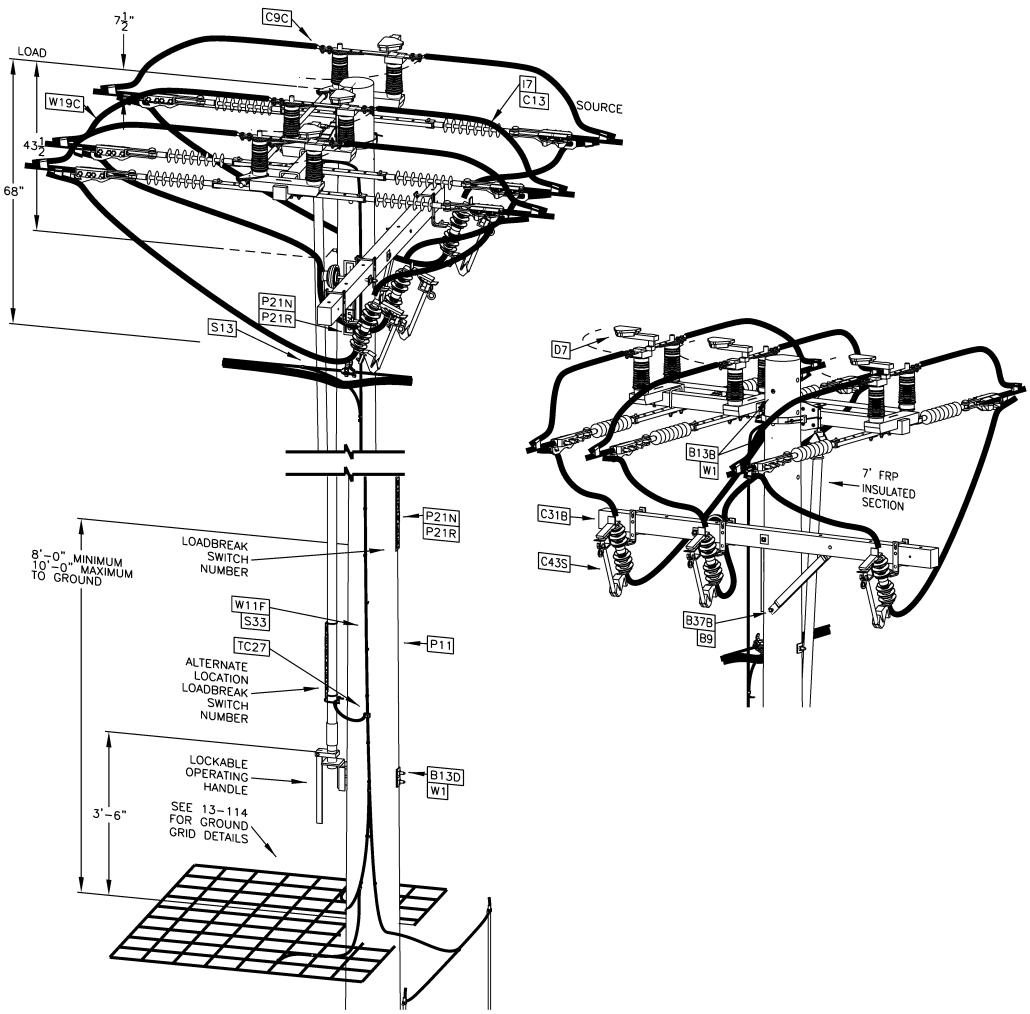
Designer	Drawing	Date
MPR	od12142	6/30/20

NOTES:
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO THE ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
3. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
4. PRIMARY CONDUCTORS SHALL NEVER BE INSTALLED TO ONLY ONE SIDE OF THE SWITCH AS MAXIMUM DEAD END LOADING WILL BE EXCEEDED.
5. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°. 0° TO 10°ANGLE DRAWING IS SHOWN.
6. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
7. OPERATING MECHANISM SHALL BE LOCKED IN THE OPEN OR CLOSED POSITION.
8. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TRAFFIC PROVIDING MAXIMUM VISIBILITY.
9. STANDARD 12-141 IS THE PREFERRED METHOD OVER DEAD ENDING ON THE SWITCH. THIS STANDARD MAY BE USED IF ADJACENT POLES ARE UPGRADED TO A CLASS H1 WITH DOUBLE DEAD -ENDED FIBERGLASS CROSS ARMS PER SECTION 4 - STORM HARDENING.
10. USE UC5G(500KCMIL CU TAP WIRE) WITH D7G(35KV 1200AMP LOADBREAK). UC5G CAN BE FOUND IN THE UG STANDARDS BOOK.
11. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

3Φ PRIMARY SECTIONALIZING – LOADBREAK SWITCH WITH SHUNT CUTOUTS INSTALLATION 15-35 KV			
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 12-143	ISSUE 7/19

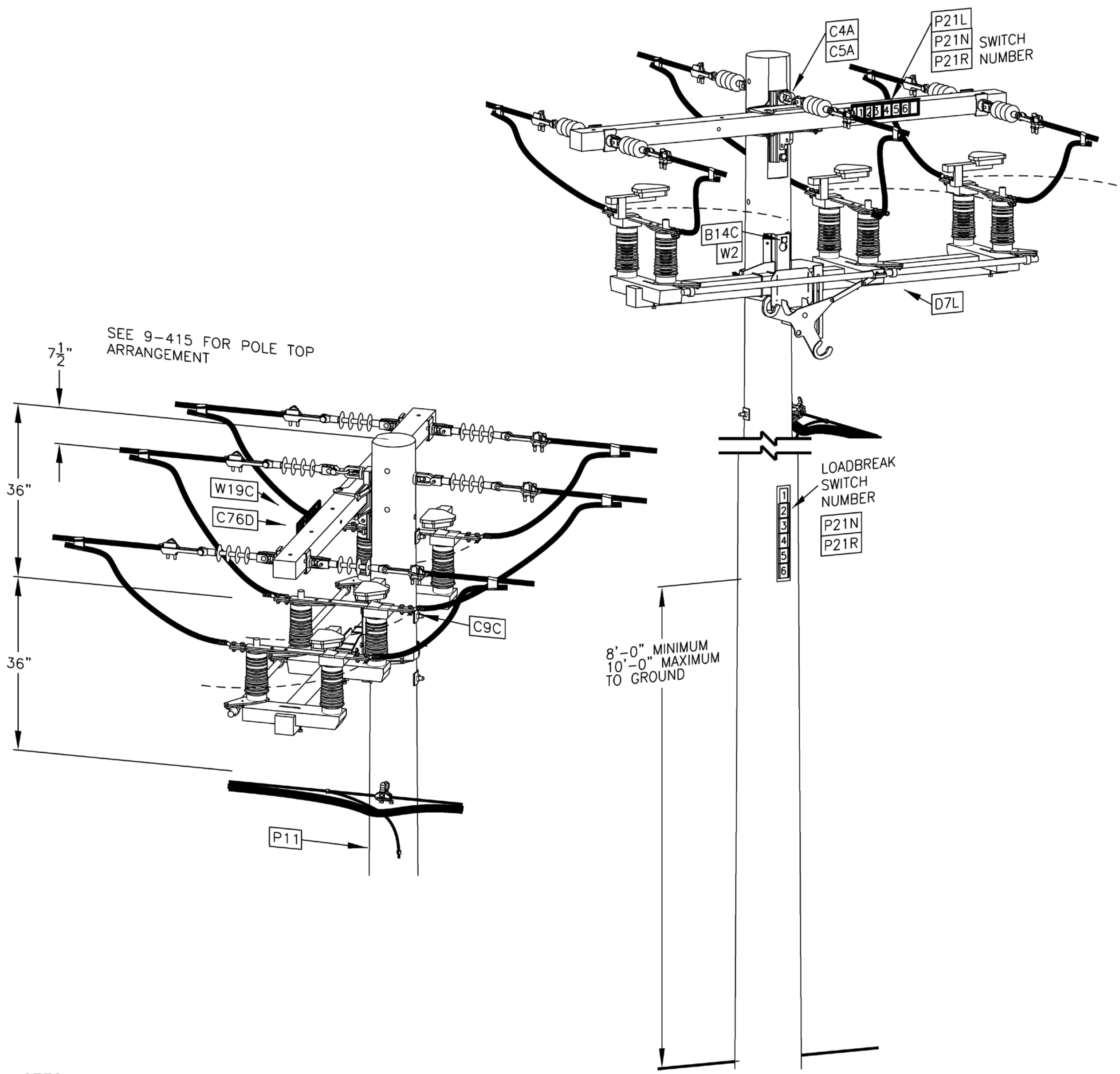
MU = @12-143LBSW15KVWCO	15 kV 3 Phase Loadbreak Switch, Plus Cutout MUs
MU = @12-143LBSW35KVWCO	35 kV 3 Phase Loadbreak Switch, Plus Cutout MUs

Supersedes 7/19 Issue – Updated Drawing



Designer	Drawing	Date
MPR	od12143	6/30/20

NOTES:
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO THE ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SHUNT FUSE CUTOUTS SHALL BE INSTALLED BELOW THE LOADBREAK SWITCH ONTO A 8' CROSSARM.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. PRIMARY CONDUCTORS SHALL NEVER BE INSTALLED TO ONLY ONE SIDE OF THE SWITCH AS MAXIMUM DEADEND LOADING WILL BE EXCEEDED.
6. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°. 0° TO 10°ANGLE DRAWING IS SHOWN.
7. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
8. OPERATING MECHANISM SHALL BE LOCKED IN THE OPEN OR CLOSED POSITION.
9. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TRAFFIC PROVIDING MAXIMUM VISIBILITY.
10. THIS STANDARD MAY BE USED IF ADJACENT POLES ARE UPGRADED TO A CLASS H1 WITH DOUBLE DEADENDED FIBERGLASS CROSSARMS PER SECTION 4 – STORM HARDENING.
11. USE UC5G(500KCMIL CU TAP WIRE) WITH D7G(35KV 1200AMP LOADBREAK). UC5G CAN BE FOUND IN THE UG STANDARDS BOOK.
12. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30



Supersedes 7/20 Issue – Updated Drawing.

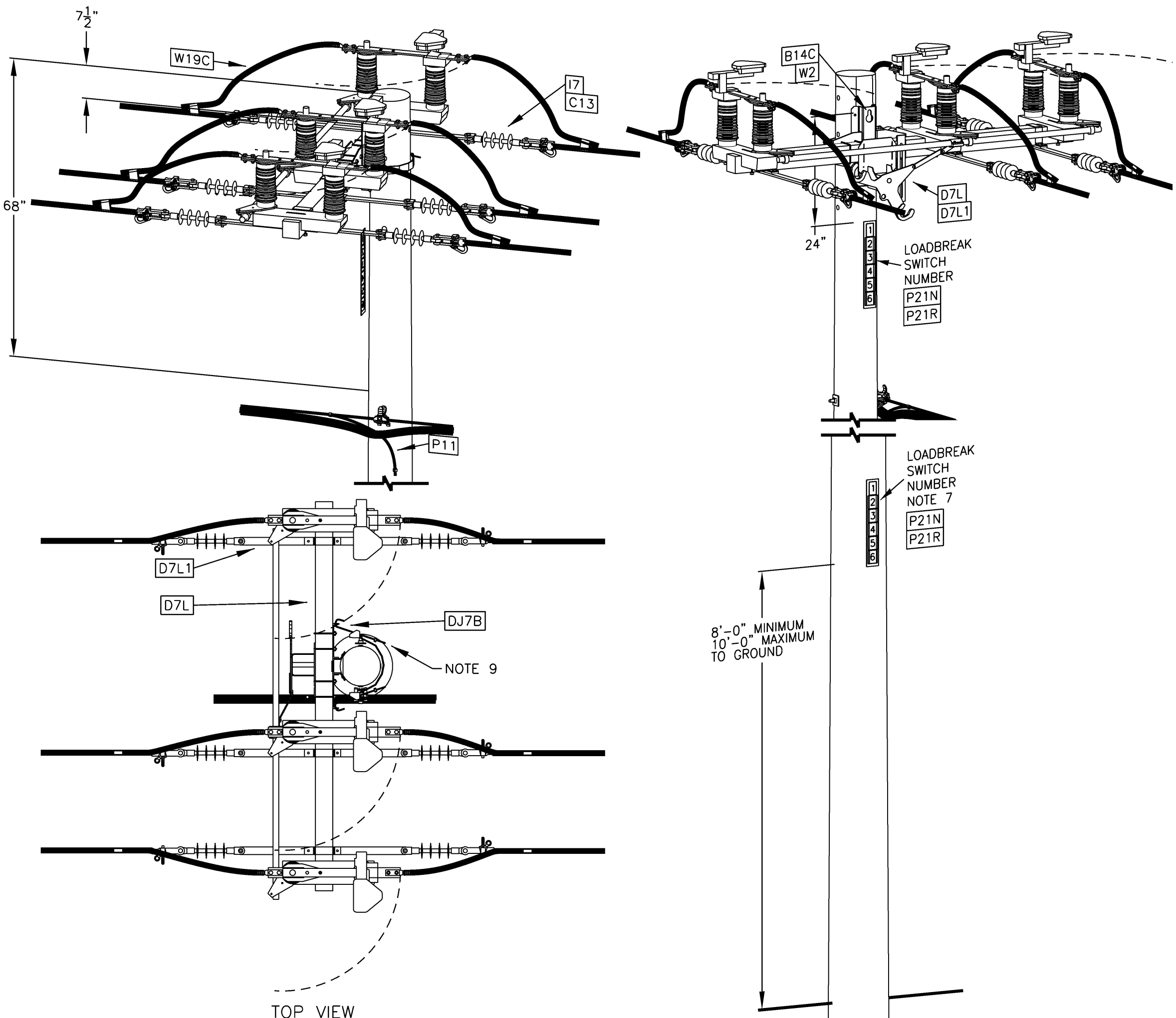
NOTES:

1. SURGE ARRESTERS SHALL BE INSTALLED ON ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'. DOWN GROUND AND/OR SURGE ARRESTERS SHALL NOT BE INSTALLED ON THE SAME POLE AS THE SWITCH INSTALLATION.
2. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
3. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
4. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°. 0° TO 10°ANGLE DRAWING IS SHOWN.
5. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
6. OPERATING MECHANISM SHALL BE LOCKED IN THE OPEN OR CLOSED POSITION.
7. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TRAFFIC PROVIDING MAXIMUM VISIBILITY.
8. ALL LOAD BREAKS WITH EXCEPTION TO HOOKSTICK SWITCH TO BE INSTALLED ON A H1 CLASS POLE AND DOUBLE DEAD ENDED ON A FIBERGLASS CROSS ARM PER SECTION 4 – STORM HARDENING.
9. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od12144	11/30/20

3Φ PRIMARY SECTIONALIZING – HOOK STICK LOADBREAK SWITCH BELOW CROSSARM INSTALLATION 15 KV

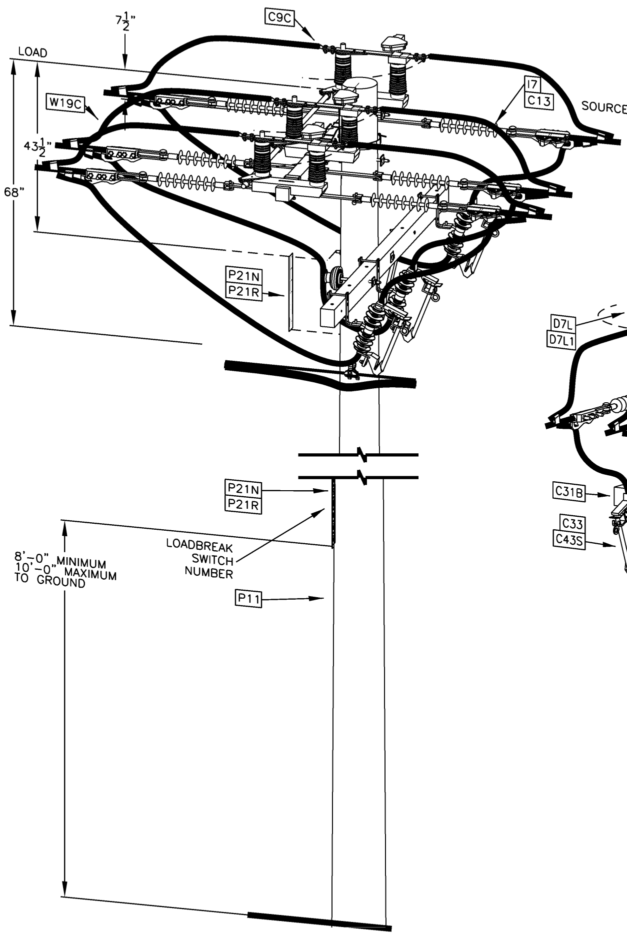
Supersedes 7/19 Issue – Added top view and note 9

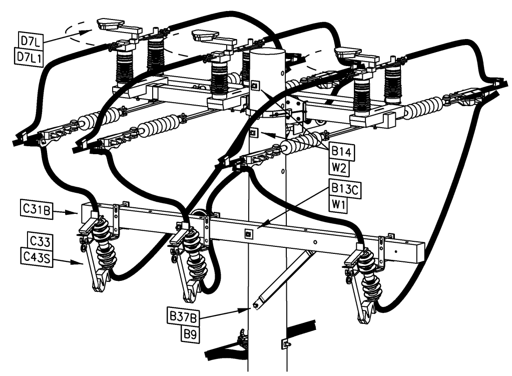


NOTES:
1. SURGE ARRESTERS SHALL BE INSTALLED ON ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'. DOWN GROUND AND/OR SURGE ARRESTERS SHALL NOT BE INSTALLED ON THE SAME POLE AS THE SWITCH INSTALLATION.
2. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
3. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
4. PRIMARY CONDUCTORS SHALL NEVER BE INSTALLED TO ONLY ONE SIDE OF THE SWITCH AS MAXIMUM DEADEND LOADING WILL BE EXCEEDED.
5. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°. 0° TO 10°ANGLE DRAWING IS SHOWN.
6. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
7. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TRAFFIC PROVIDING MAXIMUM VISIBILITY.
8. STANDARD 12-144 IS THE PREFERRED METHOD OVER DEAD ENDING ON THE SWITCH. THIS STANDARD MAY BE USED IF ADJACENT POLES ARE UPGRADED TO A H1 CLASS POLE WITH DOUBLE DEAD ENDED FIBERGLASS CROSS ARMS PER SECTION 4 - STORM HARDENING.
9. ALL LOADBREAK SWITCHES COME WITH STANDARD LENGTH J-BOLTS AND POLE BANDS FOR 61#2" TO 14"ø POLES, TO BE USED WHERE DEADENDING CONDUCTORS ON THE SWITCH. EXTENDED LENGTH 201#4" J-BOLTS ARE AVAILABLE FOR LARGER H1 POLES.
10. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od12145	6/30/20

3Φ PRIMARY SECTIONALIZING – HOOK STICK LOADBREAK SWITCH CONDUCTOR DEADEND ON SWITCH INSTALLATION 15 KV





Designer	Drawing	Date
MPR	od12146	6/30/20

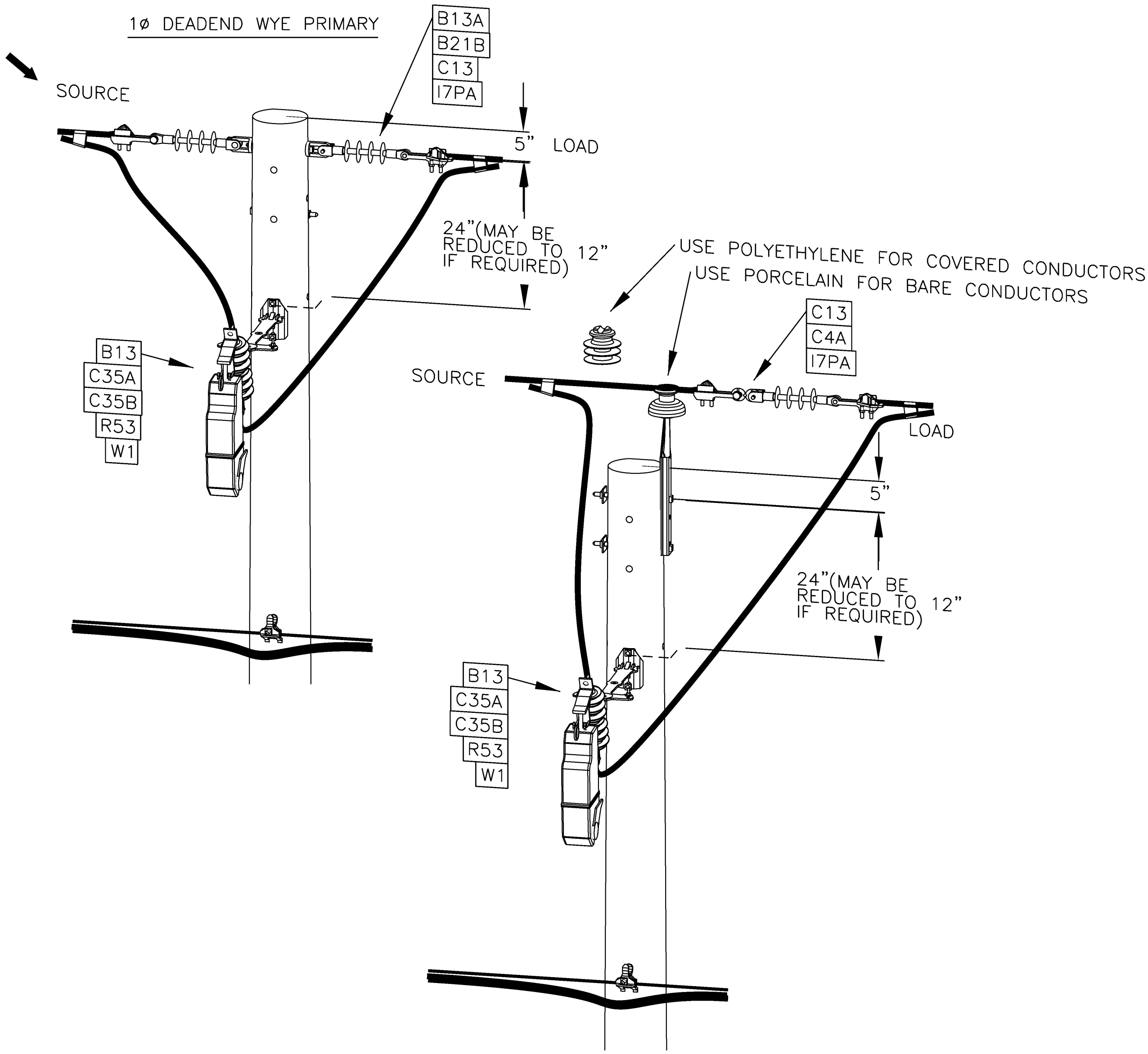
NOTES:

1. SURGE ARRESTERS SHALL BE INSTALLED ONTO THE ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. SHUNT FUSE CUTOUTS SHALL BE INSTALLED BELOW THE LOADBREAK SWITCH ONTO A 8' CROSSARM.
3. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
4. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
5. PRIMARY CONDUCTORS SHALL NEVER BE INSTALLED TO ONLY ONE SIDE OF THE SWITCH AS MAXIMUM DEADEND LOADING WILL BE EXCEEDED.
6. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°. 0° TO 10°ANGLE DRAWING IS SHOWN.
7. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
8. SWITCH IDENTIFICATION MOUNTED VERTICALLY FACING TRAFFIC PROVIDING MAXIMUM VISIBILITY.
9. THIS STANDARD MAY BE USED IF ADJACENT POLES ARE UPGRADED TO A CLASS H1 WITH DOUBLE DEADENDED FIBERGLASS CROSSARMS PER SECTION 4 – STORM HARDENING.
10. USE UC5G (500KCMIL CU TAP WIRE) WITH D7G(35KV 1200AMP LOADBREAK). UC5G CAN BE FOUND IN THE UG STANDARDS BOOK.
11. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Supersedes 7/19 Issue – Updated drawing.

7/19 - New Page.

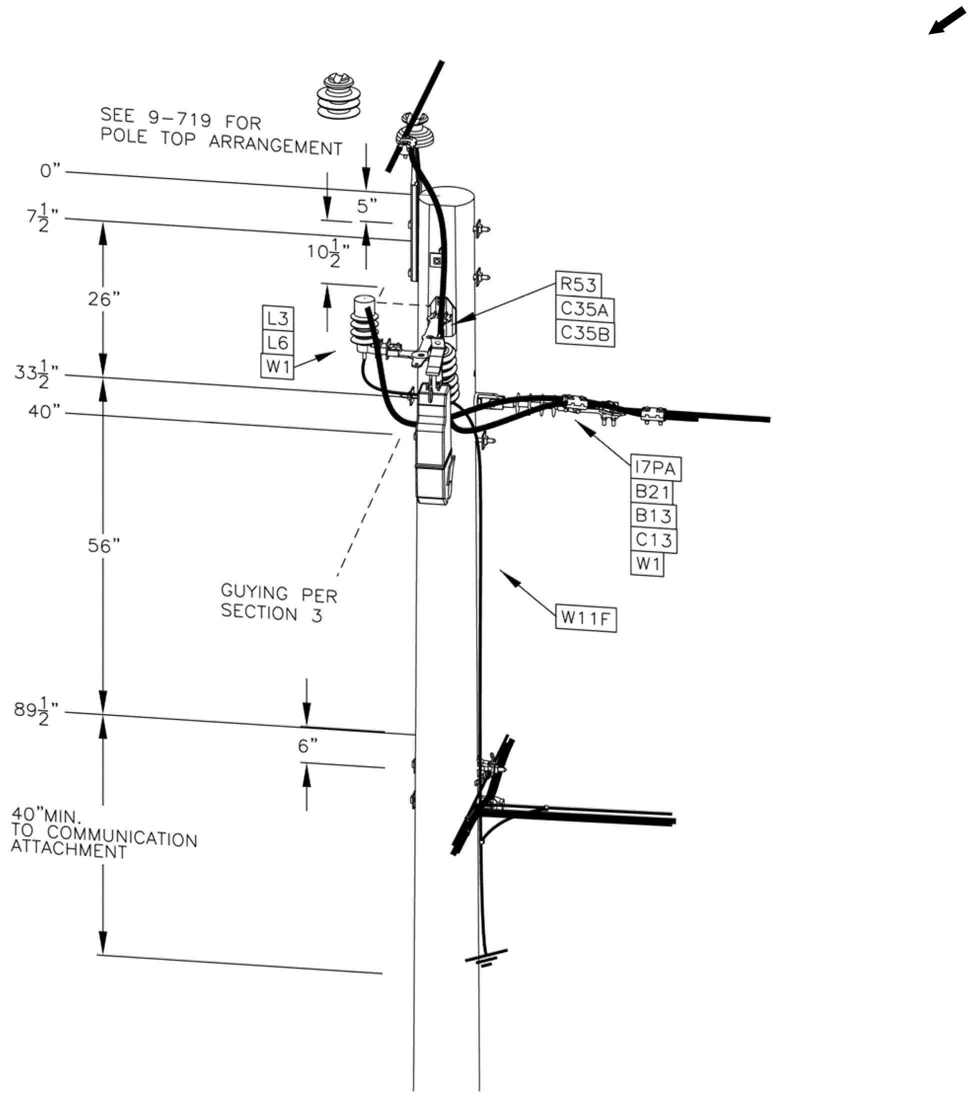
1ø DEADEND WYE PRIMARY



1ø TANGENT LINE WYE PRIMARY

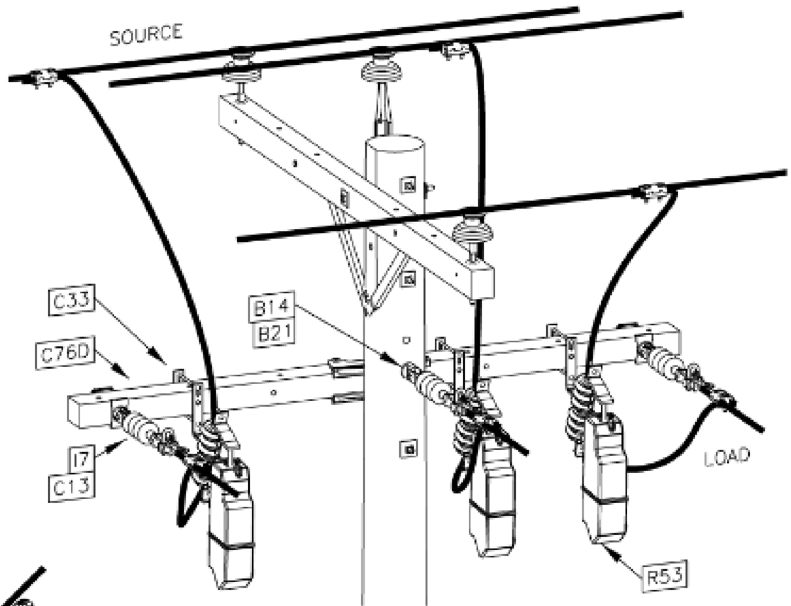
Supersedes 7/18 Issue – Corrected typo in drawing.

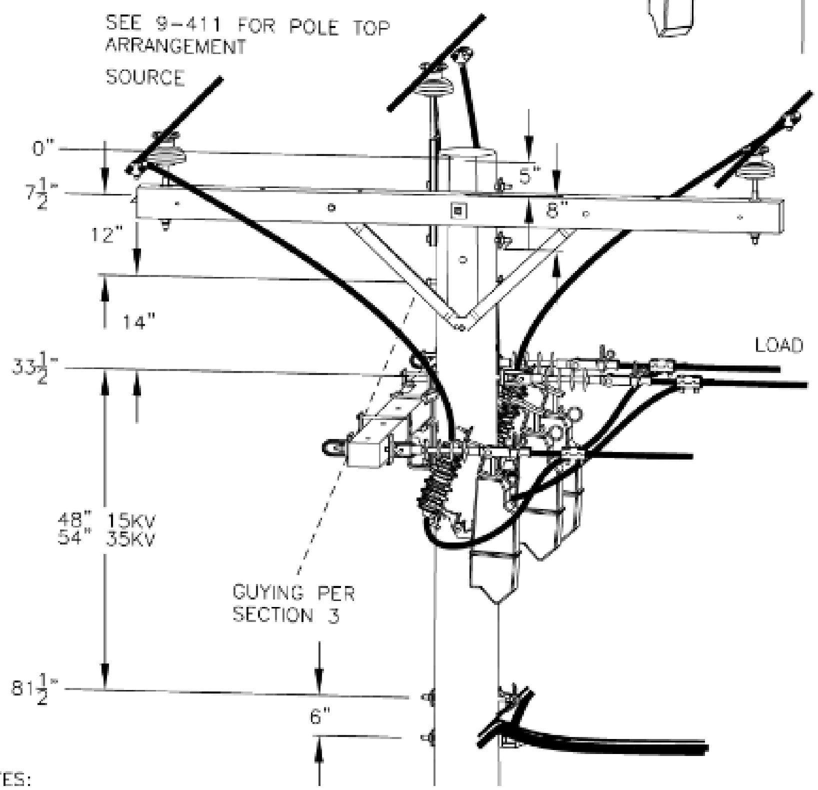
NOTES:
1. RECLOSERS MUST BE INSTALLED IN A 100AMP MACLEAN POWER SYSTEMS TYPE XS FUSE CUTOUT MOUNTING (INCLUDED WITH UNIT).
2. INSTALL TAG HOLDER (STANDARD ITEM P23E) ON POLE – 8' UP FROM GROUND LEVEL.
3. PROVIDE SUFFICIENT CLEARANCE FOR OPERATION, INSTALLATION AND REMOVAL OF UNIT.
4. INSTALL ARRESTERS ON LOAD SIDE OF RECLOSER ON SAME POLE OR ADJACENT POLES WITHIN 300'. (REFER TO SECTION 13.6.40A)
5. LOCATION, APPLICATION AND SETUP OF THIS DEVICE MUST BE DONE UNDER THE DIRECTION OF ELECTRIC OPERATIONS ENGINEERING.



NOTES:
1. RECLOSERS MUST BE INSTALLED IN A 100AMP MACLEAN POWER SYSTEMS TYPE XS FUSE CUTOUT MOUNTING (INCLUDED WITH UNIT).
2. INSTALL TAG HOLDER (STANDARD ITEM P23E) ON POLE – 8' UP FROM GROUND LEVEL.
3. PROVIDE SUFFICIENT CLEARANCE FOR OPERATION, INSTALLATION AND REMOVAL OF UNIT.
4. INSTALL ARRESTERS ON LOAD SIDE OF RECLOSER ON SAME POLE OR ADJACENT POLES WITHIN 300'. (REFER TO SECTION 13.6.40A)
5. LOCATION, APPLICATION AND SETUP OF THIS DEVICE MUST BE DONE UNDER THE DIRECTION OF ELECTRIC OPERATIONS ENGINEERING.

Designer	Drawing	Date
MPR	od12329	3/15/19





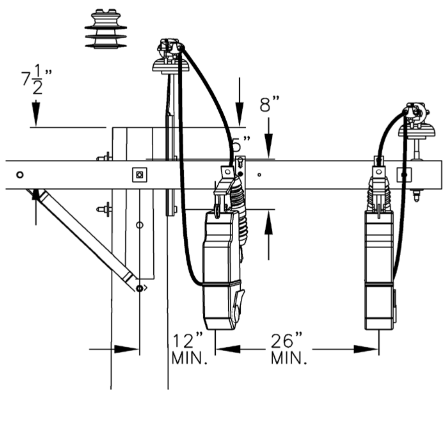
NOTES:

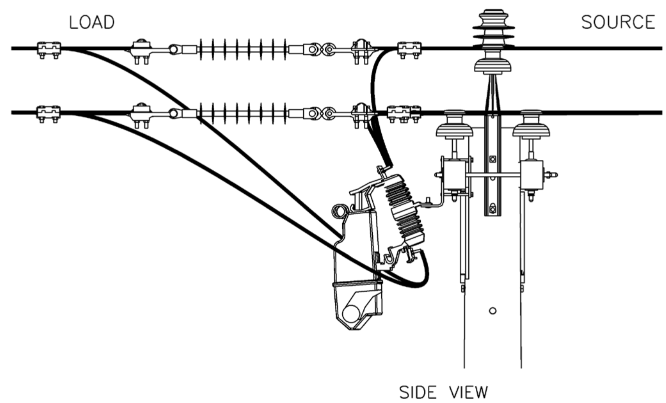
1. RECLOSURES MUST BE INSTALLED IN A 100AMP MACLEAN POWER TYPE XS FUSE CUTOUT MOUNTING. (INCLUDED WITH UNIT)
2. INSTALL TAG HOLDER (STANDARD ITEM P23E) ON POLE – 8' UP FROM GROUND LEVEL.
3. PROVIDE SUFFICIENT CLEARANCE FOR OPERATION, INSTALLATION AND REMOVAL OF UNIT.
4. INSTALL ARRESTERS ON LOAD SIDE OF RECLOSER ON SAME POLE OR ADJACENT POLES WITHIN 300'. (REFER TO SECTION 13.6.40A)
5. LOCATION, APPLICATION AND SETUP OF THIS DEVICE MUST BE DONE UNDER THE DIRECTION OD ELECTRIC OPERATIONS ENGINEERING.

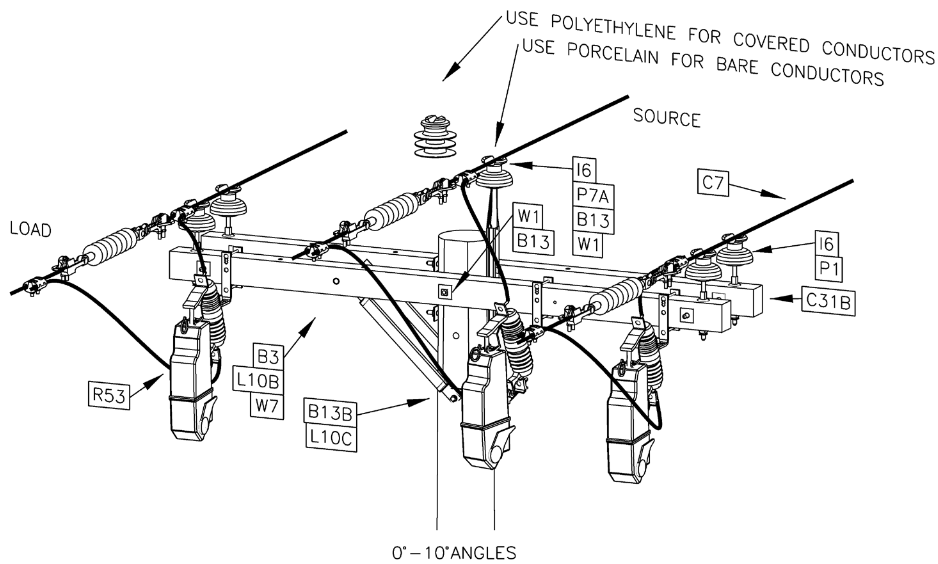
Designer	Drawing	Date
MPR	od12330	1/15/21

Supersedes 7/19 Issue – Updated material IDs.

Supersedes 7/17 Issue – Updated Drawing





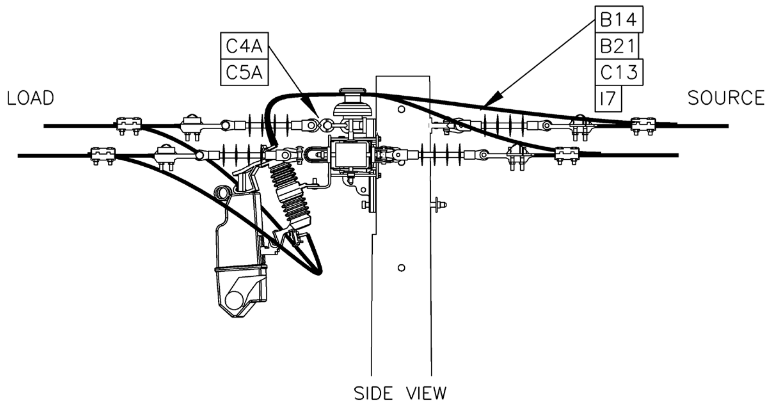


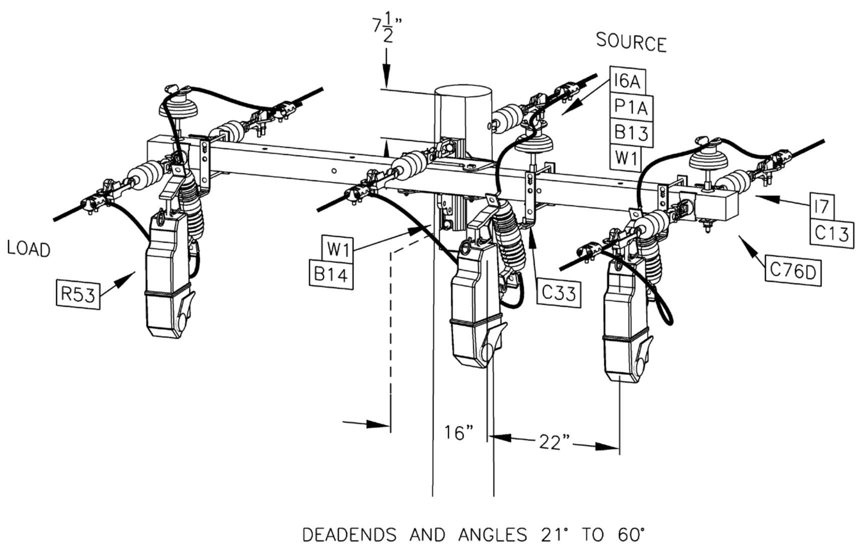
NOTES:

1. RECLOSERS MUST BE INSTALLED IN A 100AMP MACLEAN POWER SYSTEM TYPE XS FUSE CUTOUT MOUNTING. (INCLUDED WITH UNIT)
2. INSTALL TAG HOLDER (STANDARD ITEM P23E) ON POLE – 8' UP FROM GROUND LEVEL.
3. PROVIDE SUFFICIENT CLEARANCE FOR OPERATION, INSTALLATION AND REMOVAL OF UNIT.
4. INSTALL ARRESTERS ON LOAD SIDE OF RECLOSER ON SAME POLE OR ADJACENT POLES WITHIN 300'. (REFER TO SECTION 13.6.40A)
5. LOCATION, APPLICATION AND SETUP OF THIS DEVICE MUST BE DONE UNDER THE DIRECTION OF ELECTRIC OPERATIONS ENGINEERING.
6. USE DOUBLE PINS AND INSULATORS ON CROSS ARMS FOR ANGLES 11°TO 20° AND ATTACH CONDUCTOR TO SIDE GROOVE OF INSULATORS.

Designer	Drawing	Date
MPR	od12331	7/3/18

SINGLE PHASE VACUUM OPERATED CUTOUT MOUNTED RECLOSER THREE PHASE TANGENT INLINE INSTALLATION 15kV MAX





Supersedes 7/19 Issue – Updated material IDs.

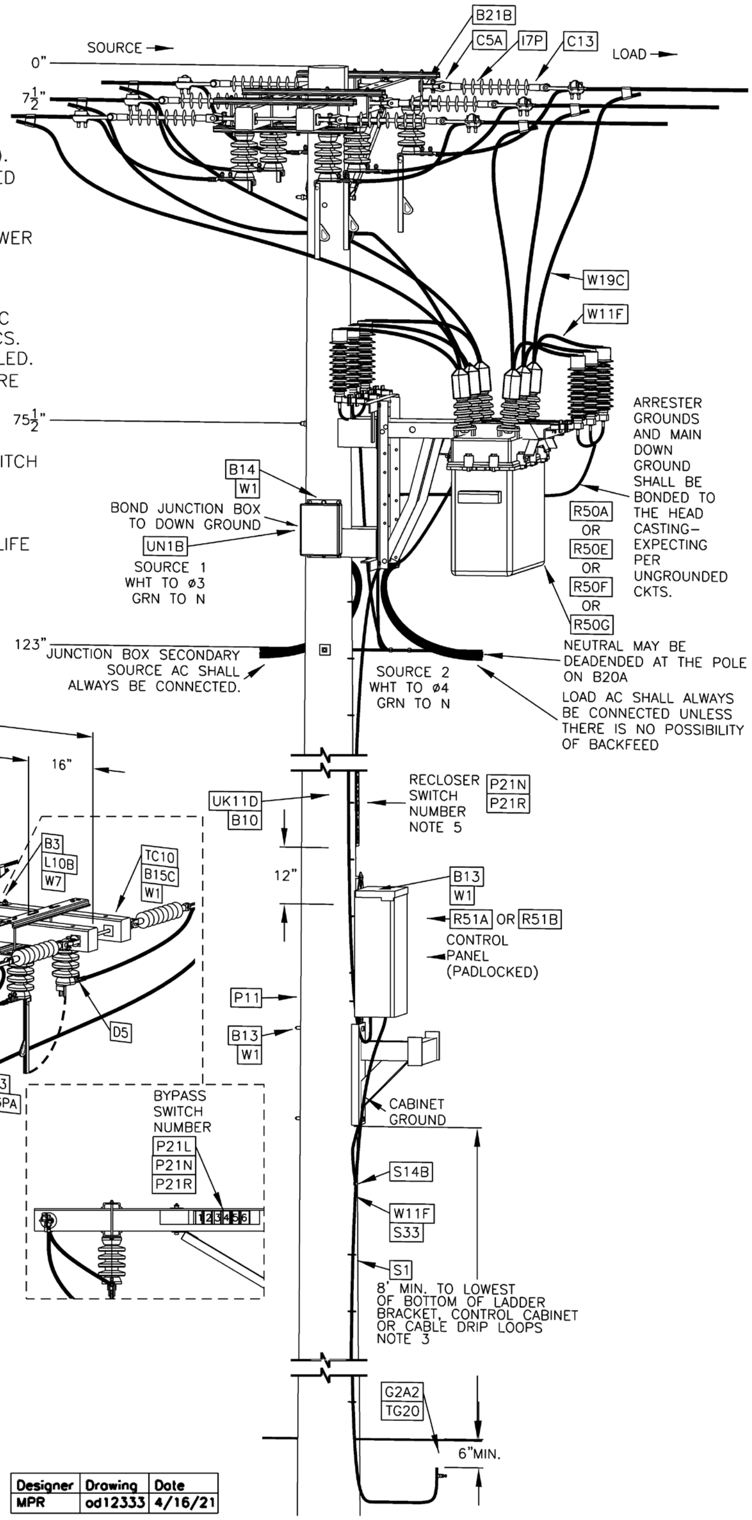
NOTES:

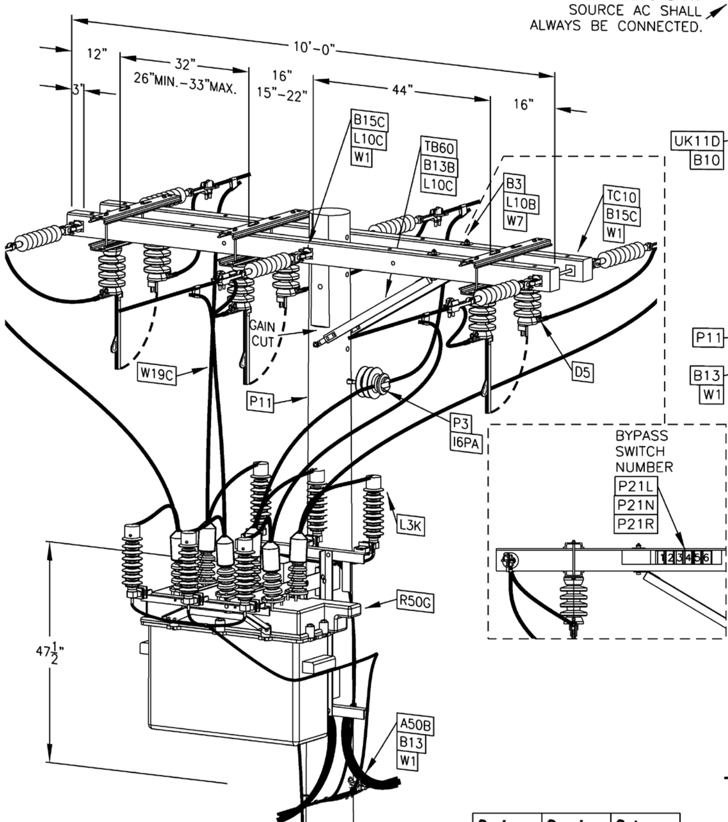
1. RECLOSERS MUST BE INSTALLED IN A 100AMP MACLEAN POWER SYSTEM TYPE XS FUSE CUTOUT MOUNTING. (INCLUDED WITH UNIT)
2. INSTALL TAG HOLDER (STANDARD ITEM P23E) ON POLE – 8' UP FROM GROUND LEVEL.
3. PROVIDE SUFFICIENT CLEARANCE FOR OPERATION, INSTALLATION AND REMOVAL OF UNIT.
4. INSTALL ARRESTERS ON LOAD SIDE OF RECLOSER ON SAME POLE OR ADJACENT POLES WITHIN 300'. (REFER TO SECTION 13.6.40A)
5. LOCATION, APPLICATION AND SETUP OF THIS DEVICE MUST BE DONE UNDER THE DIRECTION OF ELECTRIC OPERATIONS ENGINEERING.

Designer	Drawing	Date
MPR	od12332	1/15/21

NOTES:

1. IF CIRCUIT IS UNGROUNDED, GROUNDS OF ARRESTERS AND THE FRAMES OF EQUIPMENT OPERATING ABOVE 750V MUST BE RUN SEPARATELY TO GROUND, (NESC RULE 097.A).
2. SECTIONALIZING SWITCHES SHALL BE INSTALLED ONTO THE ADJACENT SOURCE OR LOAD SIDE POLE OR INSTALLED ADJACENTLY IN –LINE.
3. THE CONTROL CABINET MAY BE MOUNTED LOWER THAN 8 FEET PROVIDED SUCH CONTROL CABINETS DO NOT OVERHANG ROADWAYS OR OBSTRUCT PEDESTRIAN TRAFFIC, AND AFTER FULL CONSIDERATION OF WORKER AND PUBLIC SAFETY, POSSIBLE VANDALISM, AND AESTHETICS. A GROUND GRID (13–114) SHALL BE INSTALLED.
4. DO NOT INSTALL RECLOSER ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°.
5. CONTROL SWITCH IDENTIFICATION MOUNTED VERTICALLY ABOVE CONTROL AND BYPASS SWITCH IDENTIFICATION MOUNTED HORIZONTALLY ONTO CROSS ARM.
6. STRINGER COVER (T23) CAN BE USED FOR RECLOSER LEADS/TAPS FOR ENHANCED WILDLIFE PROTECTION.
7. SEE 12–334 WIRING.
8. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

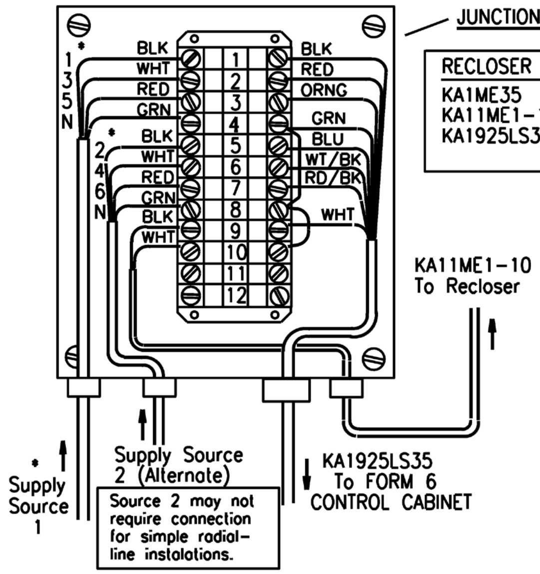




Designer	Drawing	Date
MPR	od12333	4/16/21

Supersedes 7/20 Issue – Updated material IDs.

Φ RECLOSER EFFECTIVELY GROUNDED INSTALLATION 15-35 KV



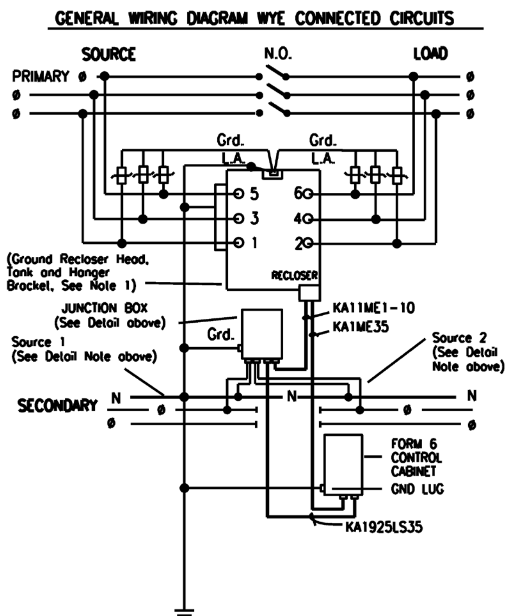
RECLOSER CABLE DESIGNATION

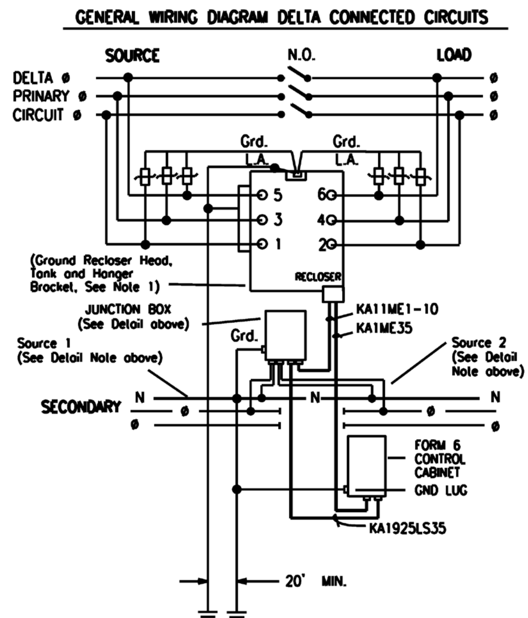
KA1ME35 -35 Ft. Control Cable
KA11ME1-10 -Input Power Cable, 10 ft.,2 pin
KA1925LS35 -Input Sensing Low Voltage Cable, 35 ft. with 10 ft. armor

*** 120V SUPPLY CONNECTIONS**

WIRE COLOR/VOLTAGE		CONNECT TO:
Source 1		
Black	120V	Bushing 1
White	120V	Bushing 3
Red	120V	Bushing 5
Green	-	Neutral
Source 2		
Black	120V	Bushing 2
White	120V	Bushing 4
Red	120V	Bushing 6
Green	-	Neutral

JUNCTION BOX WIRING DETAIL FOR WYE AND DELTA CIRCUITS





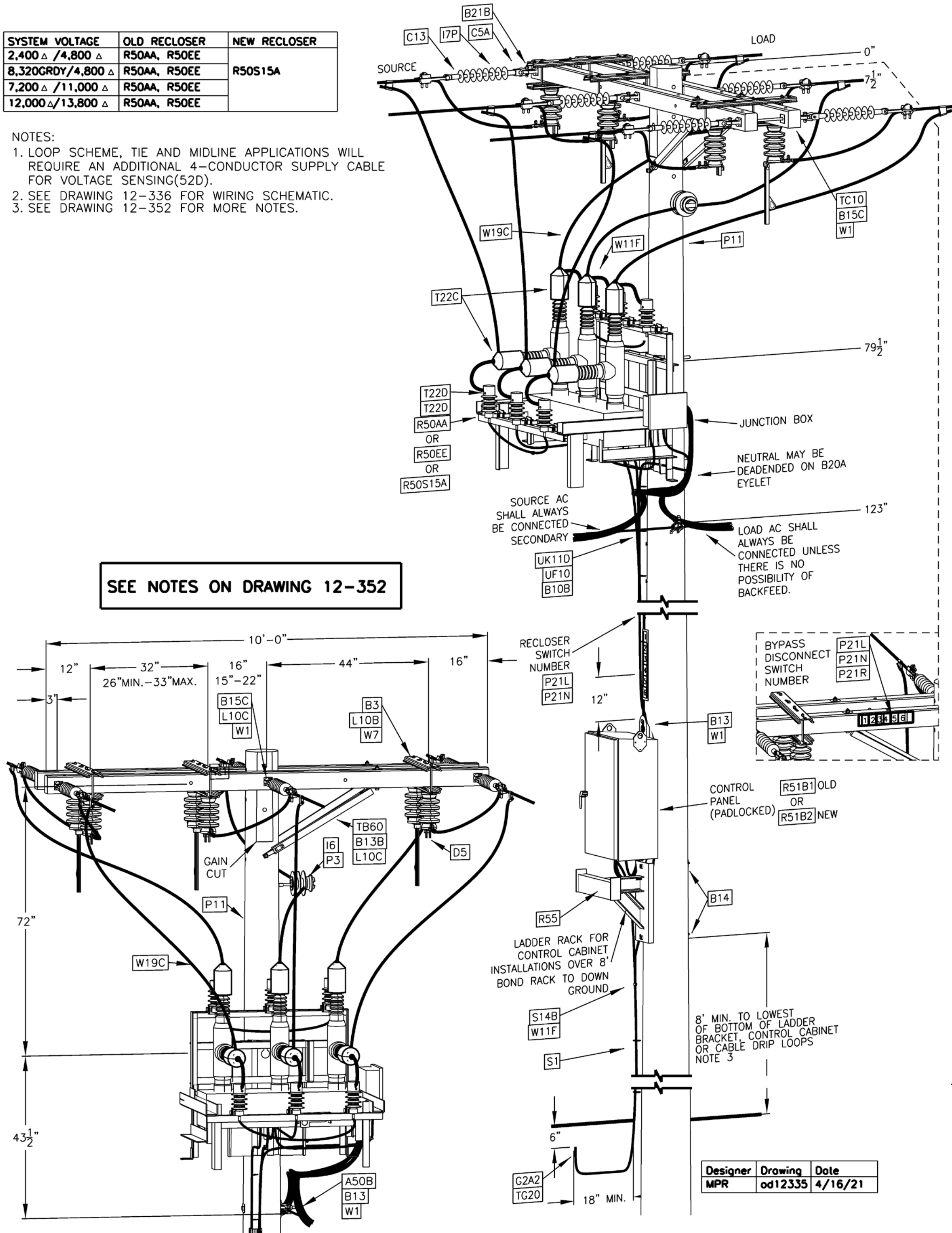
Designer	Drawing	Date
MPR	od12334	6/29/18

Supersedes 7/18 Issue – Corrected drawing title.

Supersedes 7/20 Issue – Update notes and material IDs.

SYSTEM VOLTAGE	OLD RECLOSER	NEW RECLOSER
2,400 △ /4,800 △	R50AA, R50EE	R50S15A
8,320GRDY/4,800 △	R50AA, R50EE	
7,200 △ /11,000 △	R50AA, R50EE	
12,000 △/13,800 △	R50AA, R50EE	

NOTES:
1. LOOP SCHEME, TIE AND MIDLINE APPLICATIONS WILL REQUIRE AN ADDITIONAL 4-CONDUCTOR SUPPLY CABLE FOR VOLTAGE SENSING(52D).
2. SEE DRAWING 12-336 FOR WIRING SCHEMATIC.
3. SEE DRAWING 12-352 FOR MORE NOTES.



Designer	Drawing	Date
MPR	od12335	4/16/21

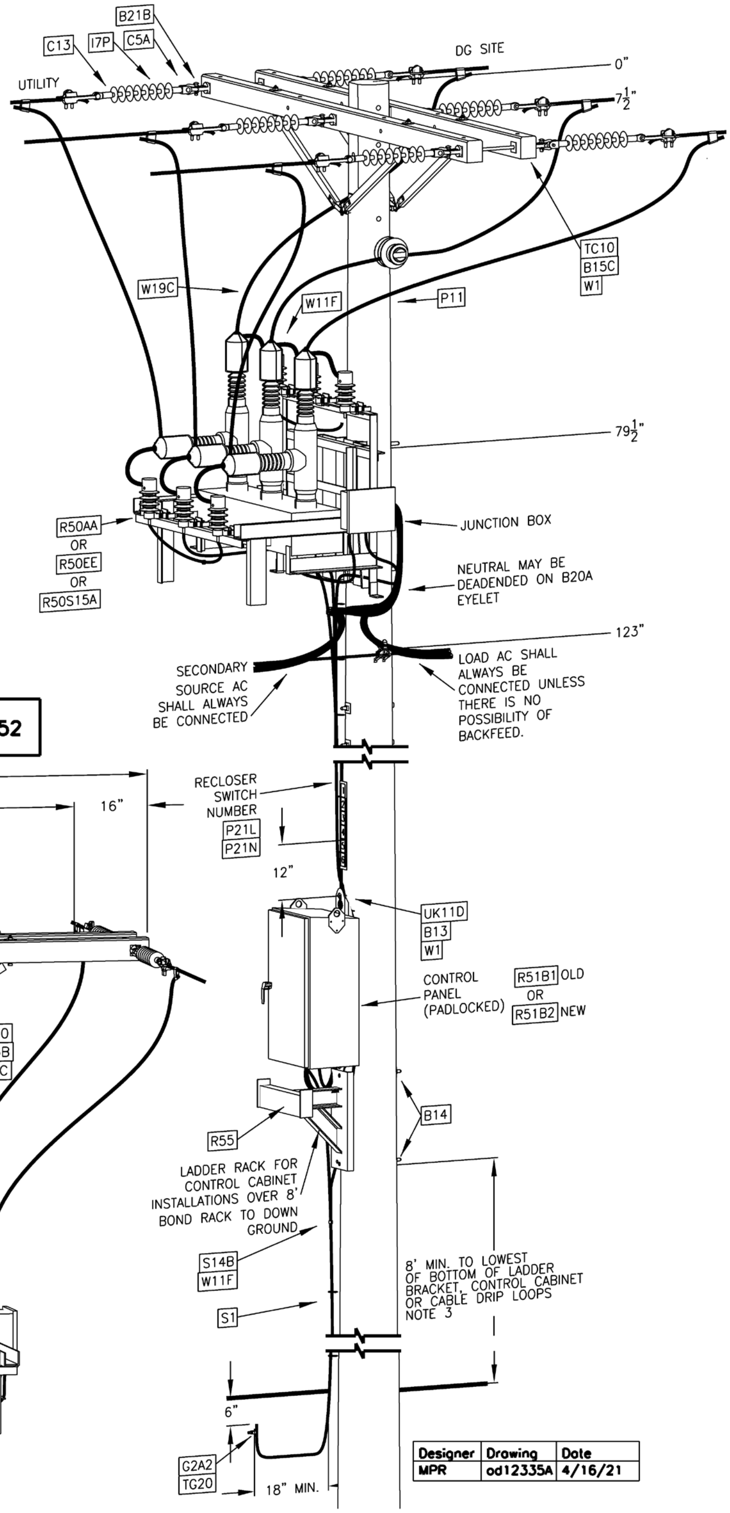
3Φ RECLOSER INSTALLATION 15kV WITH EXTERNAL MOUNTED PT'S

3Φ RECLOSER INSTALLATION 5-35 KV
EFFECTIVELY GROUNDED, NON-EFFECTIVELY GROUNDED, & DELTA SYSTEMS

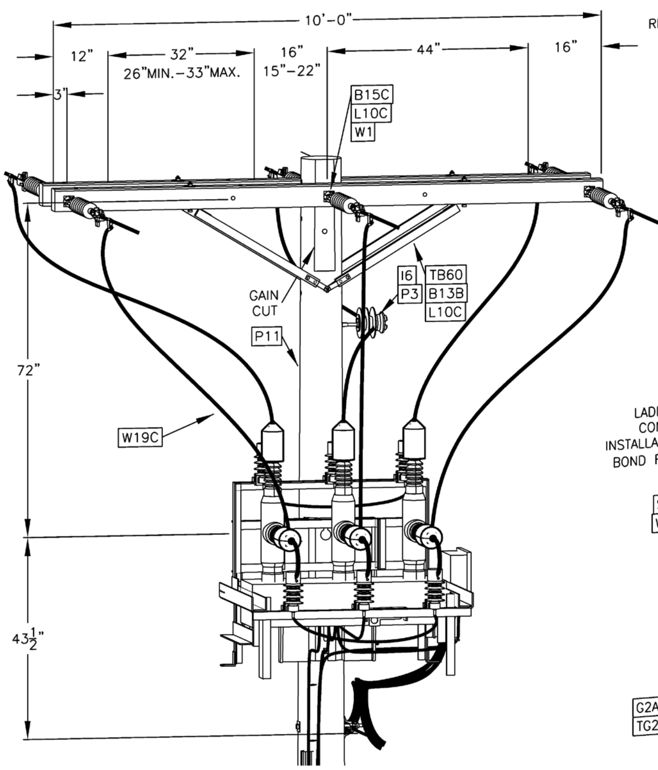
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		12-335	7/21

SYSTEM VOLTAGE	OLD RECLOSER	NEW RECLOSER
2,400 △ /4,800△	R50AA, R50EE	R50S15A
8,320GRDY/4,800 △	R50AA, R50EE	
7,200 △ /11,000 △	R50AA, R50EE	
12,000 △/13,800 △	R50AA, R50EE	

NOTES:
1. AN ADDITIONAL 4-CONDUCTOR SUPPLY CABLE FOR VOLTAGE SENSING(52C) IS REQUIRED.
2. SEE DRAWING 12-336 FOR WIRING SCHEMATIC.
3. SEE DRAWING 12-352 FOR MORE NOTES.



SEE NOTES ON DRAWING 12-352

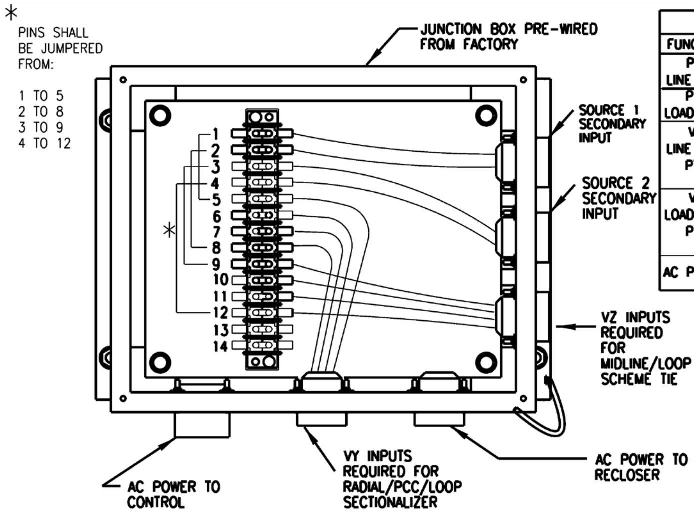


Designer	Drawing	Date
MPR	od12335A	4/16/21

3Φ RECLOSER INSTALLATION 15kV WITH EXTERNAL MOUNTED PT'S FOR DISTRIBUTED GENERATION PCC

Supersedes 7/20 Issue – Update notes and material IDs.

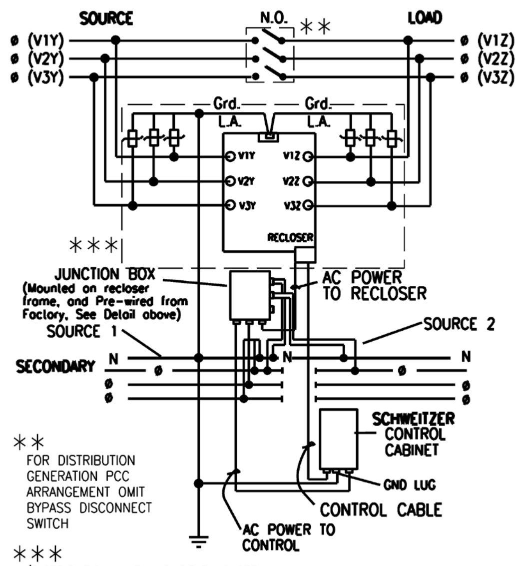
WYE AND DELTA CIRCUIT WIRING DIAGRAMS 15kV WITH EXTERNAL MOUNTED PT'S



JUNCTION BOX COLOR CODE			
FUNCTION	TERMINAL #	INPUTS	19 POSTION CONNECTOR
PT1 LINE SIDE	1	BLACK, S1 SECONDARY INPUT	ORANGE
	2	WHITE, S1 SECONDARY INPUT	WHITE
PT2 LOAD SIDE	3	BLACK, S2 SECONDARY INPUT	BROWN
	4	WHITE, S2 SECONDARY INPUT	WHITE W/VIOLET
VY LINE SIDE PTS	5	BLACK, S1 SECONDARY INPUT	YELLOW
	6	RED, S1 SECONDARY INPUT	RED W/BLACK
	7	ORANGE, S1 SECONDARY INPUT	BLUE
	8	WHITE, S1 SECONDARY INPUT	WHITE W/BLACK
VZ LOAD SIDE PTS	9	BLACK, S2 SECONDARY INPUT	BLACK
	10	RED, S2 SECONDARY INPUT	VIOLET
	11	ORANGE, S2 SECONDRY INPUT	RED
	12	WHITE, S2 SECONDARY INPUT	WHITE W/ORANGE
AC POWER	13	RED	BLUE W/BLACK
	14	WHITE	WHITE W/BLUE

120V SUPPLY CONNECTIONS		
WIRE COLOR/VOLTAGE	RADIAL/PCC/LOOP SECT.	MIDLINE/LOOP SCHEME TIE
SOURCE 1		
BLACK 120V	BUSHING V1Y	BUSHING V1Y
RED 120V	BUSHING V2Y	BUSHING V2Y
ORANGE 120V	BUSHING V3Y	BUSHING V3Y
WHITE –	NEUTRAL	NEUTRAL
SOURCE 2		
BLACK 120V	X1 LEG OF SUPPLY	BUSHING V1Z
RED 120V	NOT USED	BUSHING V2Z
ORANGE 120V	NOT USED	BUSHING V3Z
WHITE –	NEUTRAL	NEUTRAL

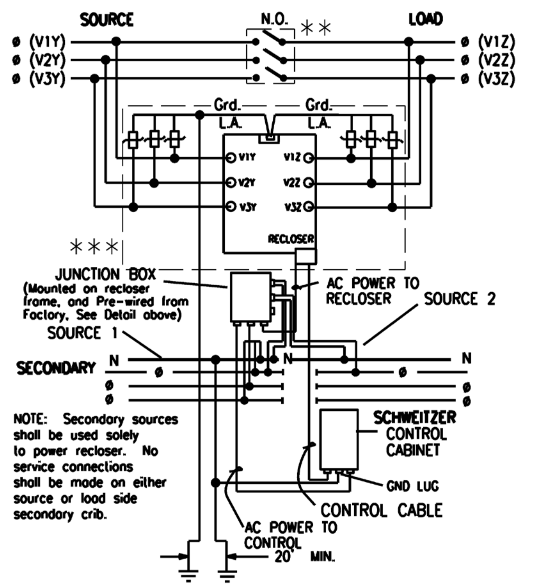
GENERAL WIRING DIAGRAM WYE CONNECTED CIRCUITS



**
FOR DISTRIBUTION GENERATION PCC ARRANGEMENT OMIT BYPASS DISCONNECT SWITCH

***
(DISTRIBUTION WYE AND DELTA SYSTEM RECLOSERS COME WITH FACTORY PRE-INSTALLED BUSHING ARRESTERS AND ANIMAL GUARDS)

GENERAL WIRING DIAGRAM DELTA CONNECTED CIRCUITS



NOTE: Secondary sources shall be used solely to power recloser. No service connections shall be made on either source or load side secondary crib.

SYSTEM VOLTAGE	OLD RECLOSER	NEW RECLOSER
2,400 △ /4,800△	R50AA, R50EE	R50S15A
8,320GRDY/4,800 △	R50AA, R50EE	
7,200 △ /11,000 △	R50AA, R50EE	
12,000△/13,800 △	R50AA, R50EE	

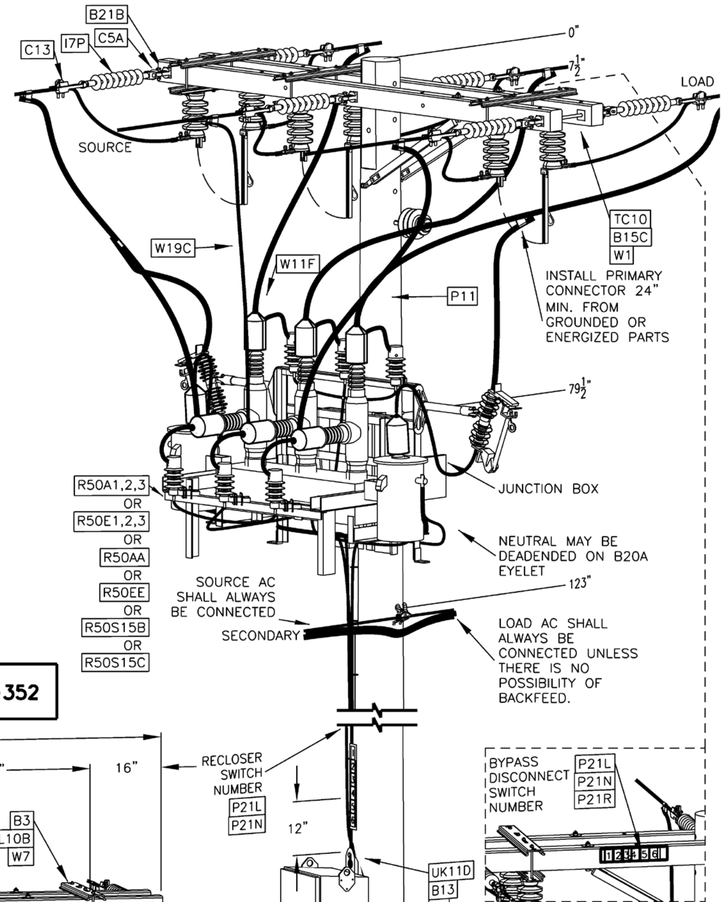
Designer	Drawing	Date
MPR	od12336	6/18/21

Supersedes 7/19 Issue – Updated notes.

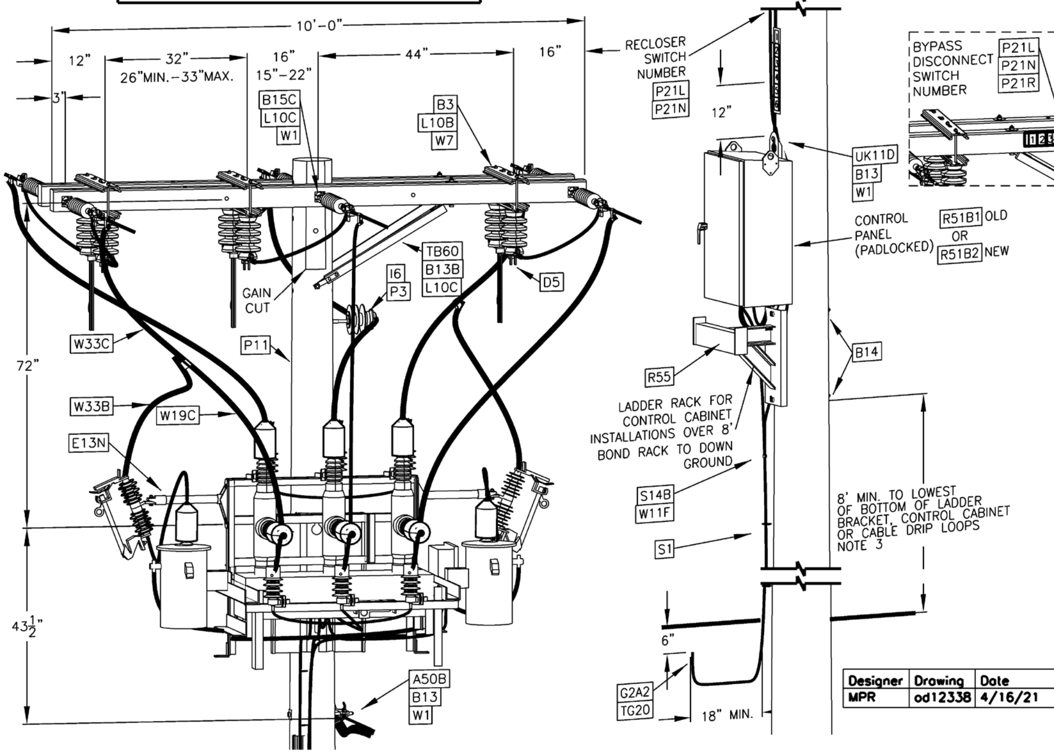
MU = @REC-3P,800A,(X)KV,(Y)WPT	Recloser, Three Phase Electronic, 800A, (X)=KV Voltage, (Y)=LP or RD With PTS
CU = REC-MT,3PH,(X)KV,12-133	Recloser, Mount, Three Phase, (X)=Nominal KV Voltage, 12-133
MU = @DSWBYPNE	Bypass Switch - NE
CU = REC-3P,CABLEFORTIER52D	Voltage Sensing Cable For Loop Scheme Tie Application

SYSTEM VOLTAGE	OLD RECLOSER	NEW RECLOSER
3,740GRDY/2,160	R50AA, R50EE	
4,160GRDY/2,400	R50AA, R50EE	R50S15B
12,470GRDY/7,200	R50A1, R50E1	
13,200GRDY/7,600	R50A2, R50E2	
13,800GRDY/7,960	R50A3, R50E3	R50S15C

NOTES:
1. SEE DRAWING 12-339 FOR WIRING SCHEMATIC.
2. SEE DRAWING 12-352 FOR MORE NOTES.



SEE NOTES ON DRAWING 12-352



3Φ RECLOSER INSTALLATION 15kV WITH FRAME MOUNTED PT'S

Supersedes 7/20 Issue – Updated notes.

G&W VIPER-S 3Φ RECLOSER EFFECTIVELY GROUNDED INSTALLATION 5 KV, 12.47 KV, 13.2 KV, 13.8 KV APPLICATIONS WITH FRAME MOUNTED PT'S

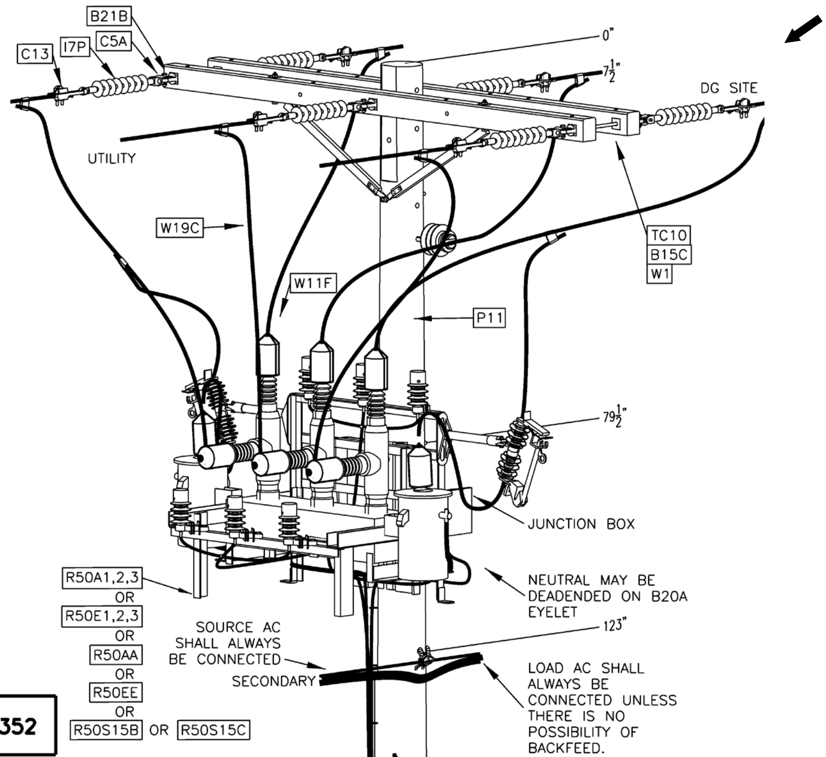
ISSUE	PAGE NUMBER		
7/21	12-338	OVERHEAD CONSTRUCTION STANDARD	ppl

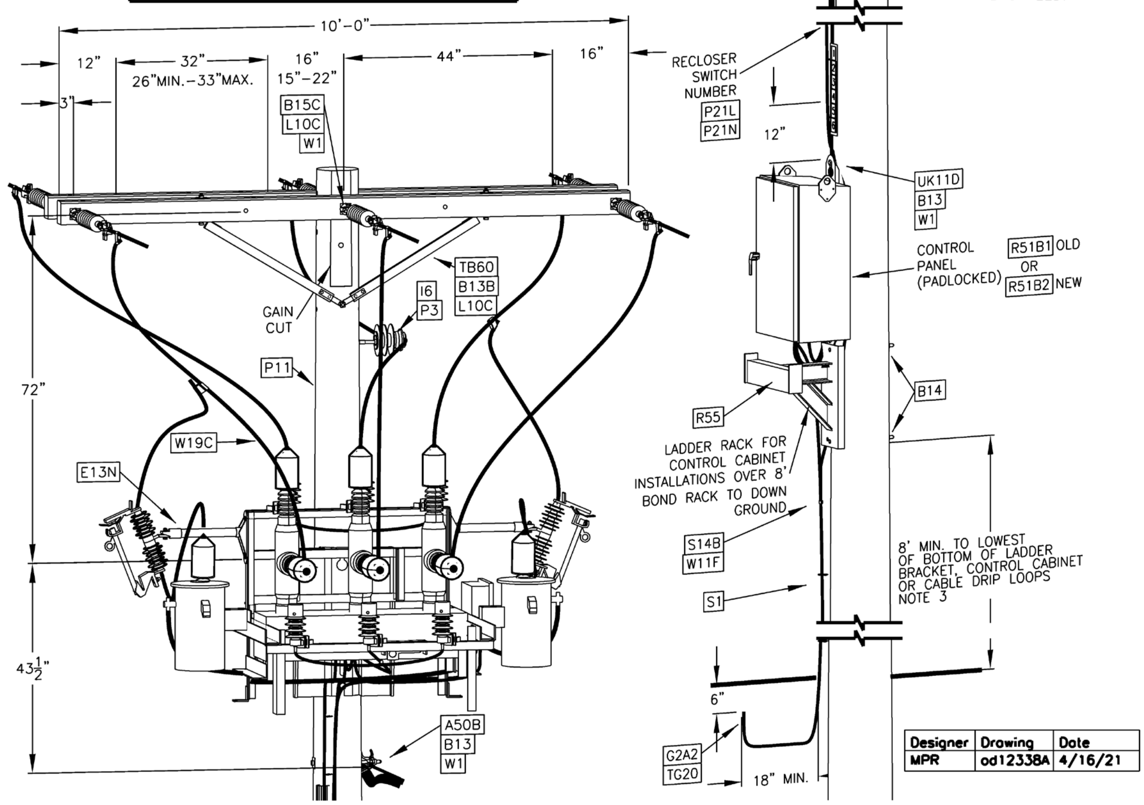
Supersedes 7/20 Issue – Updated notes.

SYSTEM VOLTAGE	OLD RECLOSER	NEW RECLOSER
3,740GRDY/2,160	R50AA, R50EE	R50S15B
4,160GRDY/2,400	R50AA, R50EE	
12,470GRDY/7,200	R50A1, R50E1	R50S15C
13,200GRDY/7,600	R50A2, R50E2	
13,800GRDY/7,960	R50A3, R50E3	

NOTES:
1. SEE DRAWING 12-339 FOR WIRING SCHEMATIC.
2. SEE DRAWING 12-352 FOR MORE NOTES.

SEE NOTES ON DRAWING 12-352





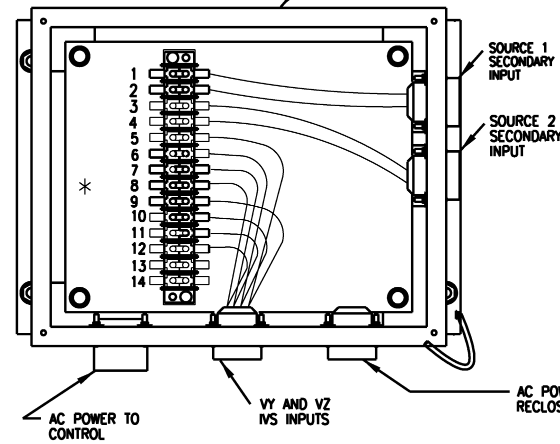
Designer	Drawing	Date
MPR	od12338A	4/16/21

3Φ RECLOSER INSTALLATION 15kV WITH IVS AND FRAME MOUNTED PT'S FOR DISTRIBUTED GENERATION PCC

G&W VIPER-S 3Φ RECLOSER INSTALLATION 5 KV, 12.47 KV, 13.2 KV, 13.8 KV APPLICATIONS WITH FRAME MOUNTED PT'S DISTRIBUTED GENERATION PCC

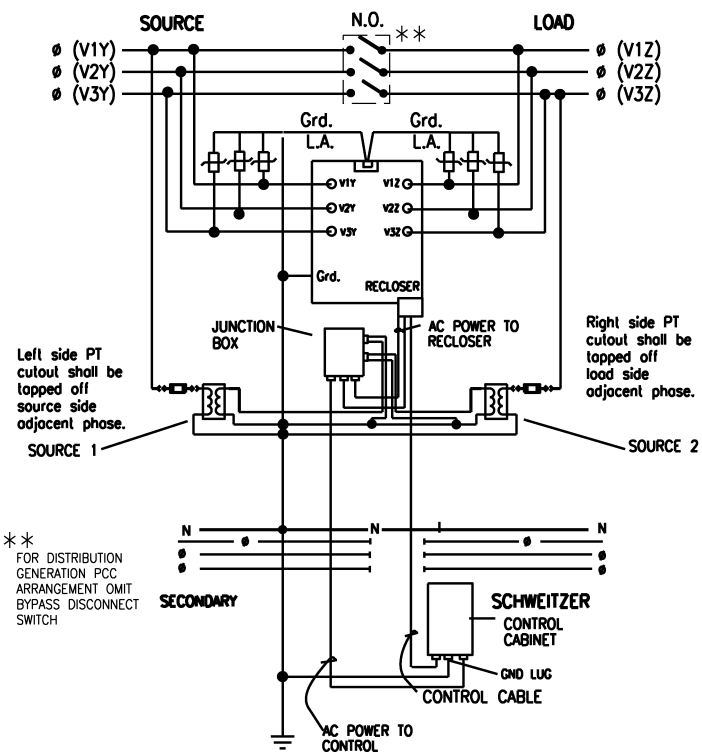
		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	12-338A	7/21

GENERAL WIRING DIAGRAM 15kV WITH IVS AND FRAME MOUNTED PT'S



JUNCTION BOX COLOR CODE			
FUNCTION	TERMINAL #	INPUTS	19 POSTION CONNECTOR
PT1 LINE SIDE	1	BLACK, S1 SECONDARY INPUT	ORANGE
	2	WHITE, S1 SECONDARY INPUT	WHITE
PT2 LOAD SIDE	3	BLACK, S2 SECONDARY INPUT	BROWN
	4	WHITE, S2 SECONDARY INPUT	WHITE W/VIOLET
VY IVS LINE SIDE PTS	5	BLACK, S1 SECONDARY INPUT	YELLOW
	6	RED. S1 SECONDARY INPUT	RED W/BLACK
	7	ORANGE, S1 SECONDARY INPUT	BLUE
	8	WHITE, S1 SECONDARY INPUT	WHITE W/BLACK
VZ IVS LOAD SIDE PTS	9	BLACK, S2 SECONDARY INPUT	BLACK
	10	RED, S2 SECONDARY INPUT	VIOLET
	11	ORANGE, S2 SECONDRY INPUT	RED
	12	WHITE, S2 SECONDARY INPUT	WHITE W/ORANGE
AC POWER	13	RED	BLUE W/BLACK
	14	WHITE	WHITE W/BLUE

120V SUPPLY CONNECTION IS FACTORY WIRED FROM FRAME MOUNTED PT'S

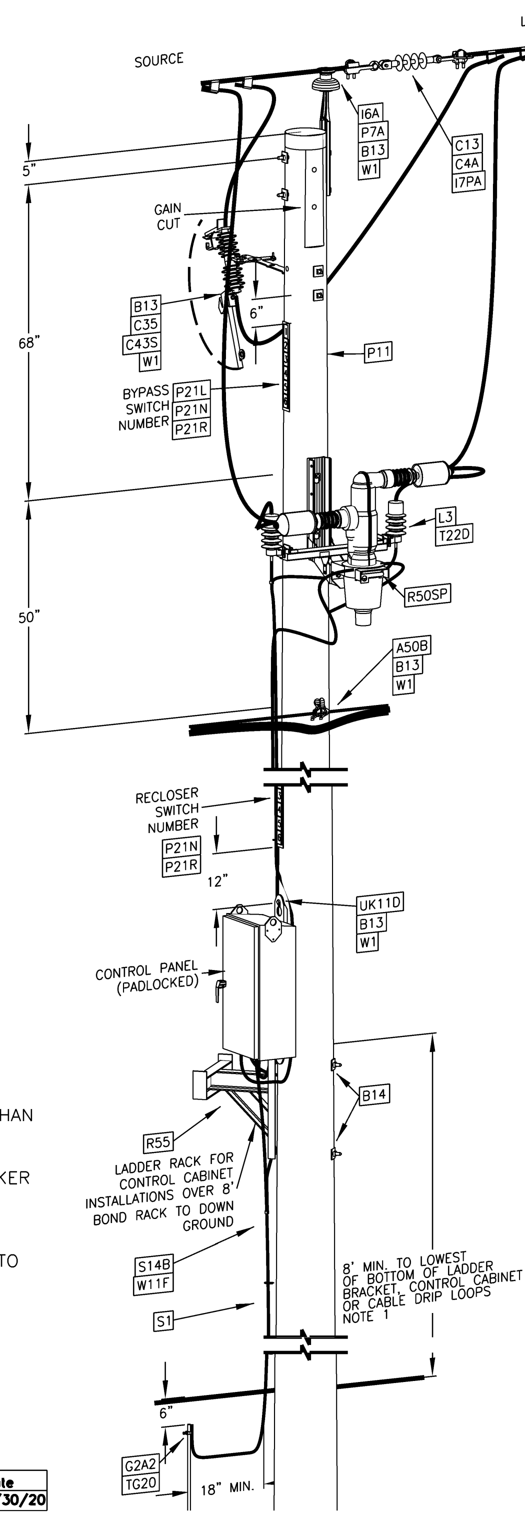


** FOR DISTRIBUTION GENERATION PCC ARRANGEMENT OMIT BYPASS DISCONNECT SWITCH

SYSTEM VOLTAGE	OLD RECLOSER	NEW RECLOSER
3,740GRDY/2,160	R50AA, R50EE	
4,160GRDY/2,400	R50AA, R50EE	R50S15B
12,470GRDY/7,200	R50A1, R50E1	
13,200GRDY/7,600	R50A2, R50E2	
13,800GRDY/7,960	R50A3, R50E3	R50S15C

Designer	Drawing	Date
MPR	od12339	7/15/19

Supersedes 7/19 Issue – Updated drawing title



NOTES:

1. THE CONTROL CABINET MAY BE MOUNTED LOWER THAN 8' PROVIDED SUCH CONTROL CABINETS DO NOT OVERHANG ROADWAYS OR OBSTRUCT PEDESTRIAN TRAFFIC, AND AFTER FULL CONSIDERATION OF WORKER AND PUBLIC SAFETY, POSSIBLE VANDALISM, AND AESTHETICS, A GROUND GRID (13–114) SHALL BE INSTALLED.
2. SECTIONALIZING SWITCHES SHALL BE INSTALLED ONTO THE ADJACENT SOURCE SIDE POLE OR INSTALLED ADJACENTLY IN-LINE.
3. CUTOUT FUSE HOLDER OF BYPASS CUTOUT TO BE STAPLED TO POLE WHEN NOT IN BYPASS MODE. CUTOUT TO BE SIZED ACCORDINGLY.
4. SOME AREAS REQUIRE A (R55) LADDER BRACKET WHEN MOUNTING THE CONTROL CABINET ABOVE 8'. THE BOTTOM OF THE LADDER BRACKET TO BE INSTALLED AT 8'.

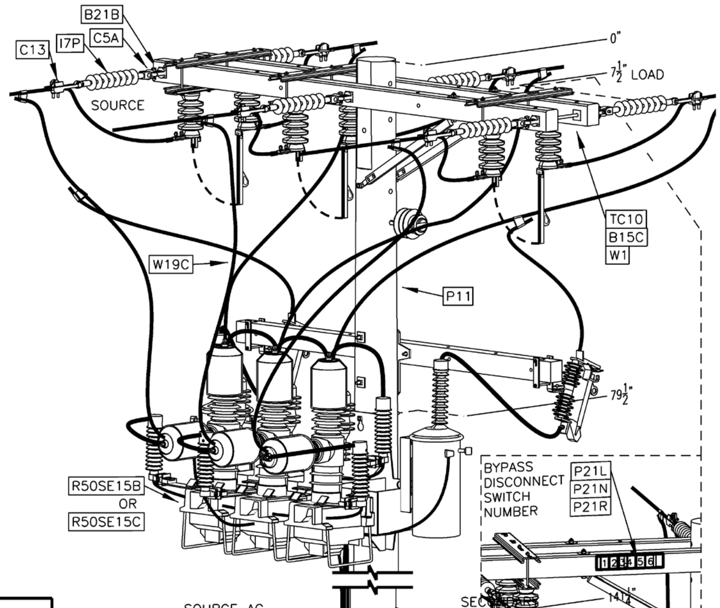
Designer	Drawing	Date
MPR	od12341	6/30/20

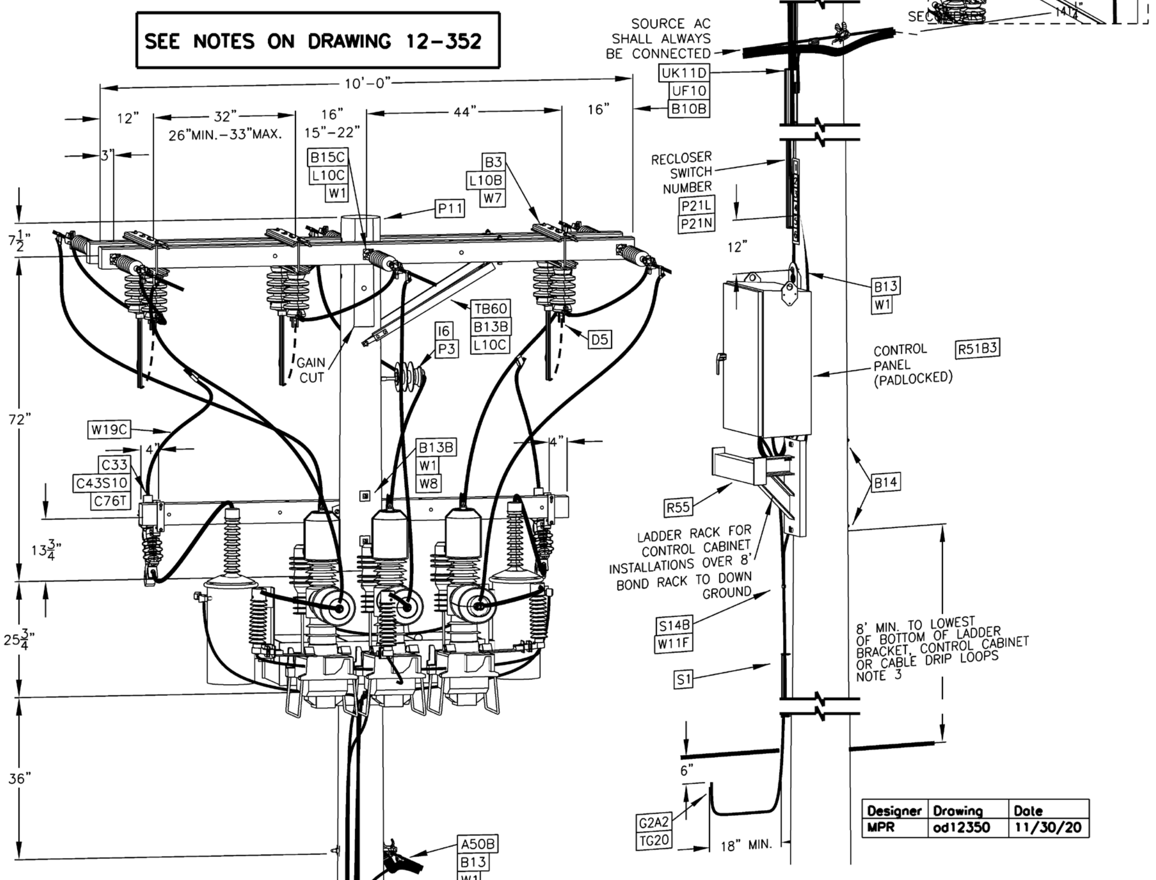
15KV SINGLE PHASE RECLOSER

MU = @REC-5KV,NXT6IVS,PKG-P	Recloser, Three Phase Electronic, 800A, 5KV
MU = @REC-15KV,NXT6IVS,PKG-Q	Recloser, Three Phase Electronic, 800A, 15KV
MU = @DSWBYPNE	Bypass Switch - NE

SYSTEM VOLTAGE	NEW RECLOSER
3,740GRDY/2,160	
4,160GRDY/2,400	R50SE15B
12,470GRDY/7,200	
13,200GRDY/7,600	
13,800GRDY/7,960	R50SE15C

NOTES:
1. SEE DRAWING 12-351 FOR WIRING SCHEMATIC.
2. SEE DRAWING 12-352 FOR MORE NOTES.





3φ RECLOSER INSTALLATION 5kV, 15kV WITH FRAME MOUNTED PT'S

Designer	Drawing	Date
MPR	od12350	11/30/20

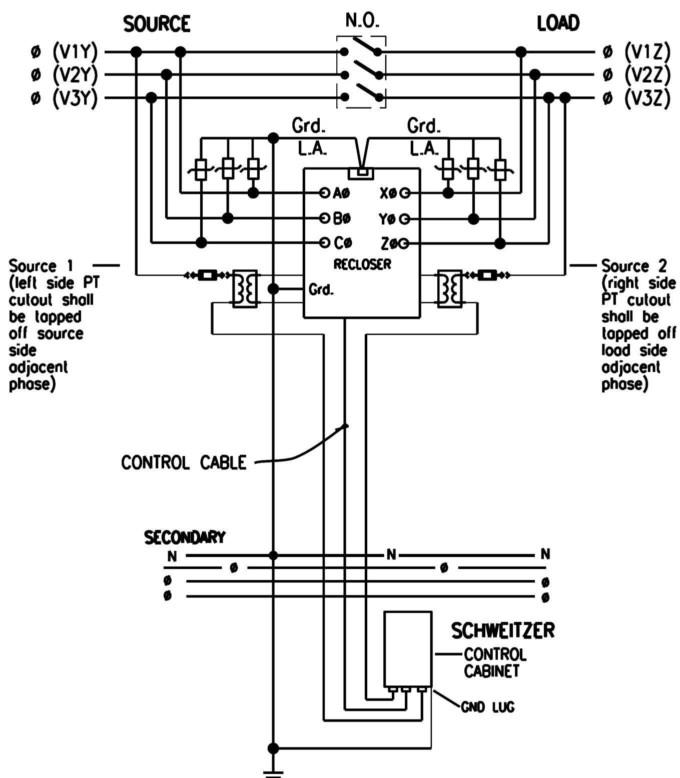
Supersedes 7/20 Issus – Updated notes and material IDs.

EATON NOVA NX-T 3ϕ RECLOSER EFFECTIVELY GROUNDED INSTALLATION
5 KV, 12.47 KV, 13.2 KV, 13.8 KV APPLICATIONS WITH FRAME MOUNTED PT'S

ISSUE	PAGE NUMBER		
7/21	12-350	OVERHEAD CONSTRUCTION STANDARD	ppl

7/20 – New page

GENERAL WIRING DIAGRAM 5kV, 15kV WITH IVS AND FRAME MOUNTED PTS



SYSTEM VOLTAGE	NEW RECLOSER
3,740GRDY/2,160	
4,160GRDY/2,400	R50SE15B
12,470GRDY/7,200	
13,200GRDY/7,600	
13,800GRDY/7,960	R50SE15C

Designer	Drawing	Date
MPR	od12351	3/6/20

NOTES FOR RECLOSER DRAWINGS 12-335, 12-335A, 12-338, 12-338A, 12-350 AND 12-360:

1. FOR DELTA CIRCUITS, SECONDARY SOURCES SHALL BE USED SOLELY TO POWER THE RECLOSER, NO SERVICE CONNECTIONS SHALL BE MADE ON EITHER SOURCE OR LOAD SIDE SECONDARY CRIB.
2. SECTIONALIZING SWITCHES SHALL BE INSTALLED ONTO THE ADJACENT SOURCE OR LOAD SIDE POLE OR INSTALLED ADJACENTLY IN -LINE.
3. THE CONTROL CABINET MAY BE MOUNTED LOWER THAN 8' PROVIDED SUCH CONTROL CABINETS DO NOT OVERHANG ROADWAYS OR OBSTRUCT PEDESTRIAN TRAFFIC, AND AFTER FULL CONSIDERATION OF WORKER AND PUBLIC SAFETY, POSSIBLE VANDALISM, AND AESTHETICS. A GROUND GRID (13-114) SHALL BE INSTALLED.
4. DO NOT INSTALL RECLOSER ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°.
5. CONTROL SWITCH IDENTIFICATION MOUNTED VERTICALLY ABOVE CONTROL AND BYPASS SWITCH IDENTIFICATION MOUNTED HORIZONTALLY ONTO CROSS ARM.
6. STRINGER COVER (T23) CAN BE USED FOR RECLOSER LEADS/TAPS FOR ENHANCED WILDLIFE PROTECTION.
7. SOME AREAS REQUIRE A (R55) LADDER BRACKET WHEN MOUNTING THE CONTROL CABINET ABOVE 8'.
8. ALL NEW RECLOSER INSTALLATIONS SHALL BE MOUNTED ON A CLASS H1 POLE OR ADJACENT POLES SHALL BE UPGRADED TO AN H1 POLE WITH DOUBLE DEAD ENDED FIBERGLASS CROSS ARMS AS REQUIRED BY SECTION 4 – STORM HARDENING.
9. SEE SECTION 25 FOR TELECOM REQUIREMENTS.
10. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30
11. THE U DUCT THAT COVERS THE CONTROL AND POWER CABLES SHALL BE SEALED AT BOTH ENDS WITH EXPANDING FOAM (UF10).

New page – 7/21 Issue.

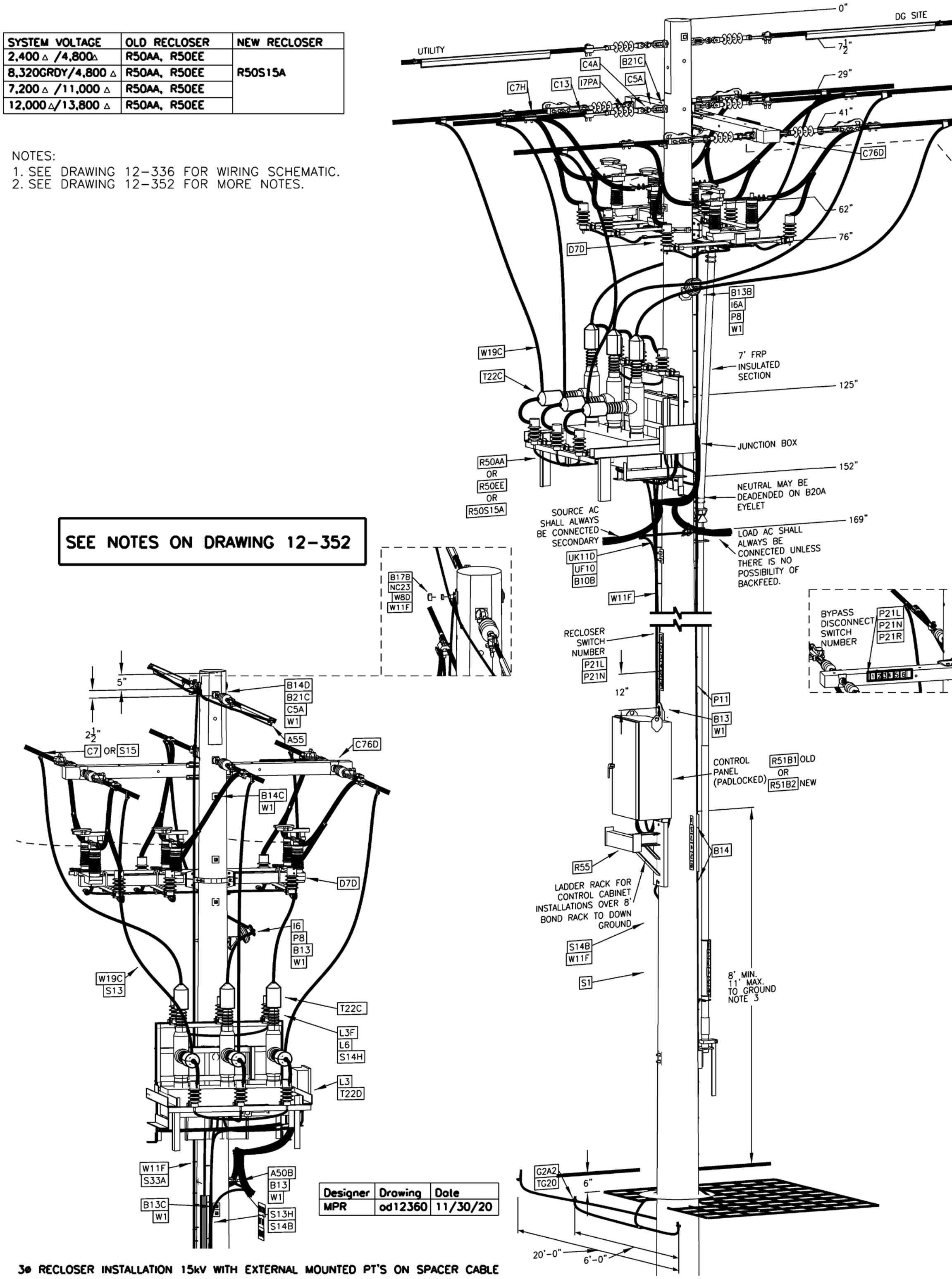
Designer	Drawing	Date
MPR	od12352	7/9/21

SYSTEM VOLTAGE	OLD RECLOSER	NEW RECLOSER
2,400 △ /4,800△	R50AA, R50EE	
8,320GRDY/4,800 △	R50AA, R50EE	R50S15A
7,200 △ /11,000 △	R50AA, R50EE	
12,000△/13,800 △	R50AA, R50EE	

NOTES:
1. SEE DRAWING 12-336 FOR WIRING SCHEMATIC.
2. SEE DRAWING 12-352 FOR MORE NOTES.

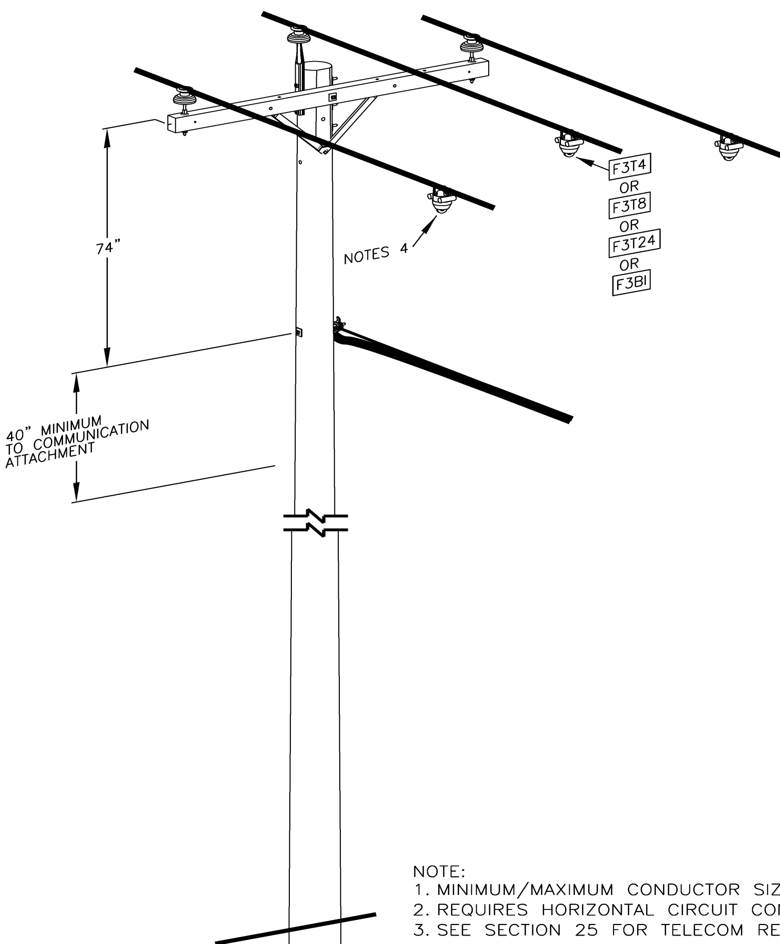
SEE NOTES ON DRAWING 12-352

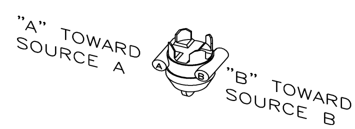
7/21 Issue – Added note 6.



Designer	Drawing	Date
MPR	od12360	11/30/20

3Φ RECLOSER INSTALLATION 15kV WITH EXTERNAL MOUNTED PT'S ON SPACER CABLE





DIRECTIONAL FAULT CURRENT INDICATOR

7/20 New Drawing

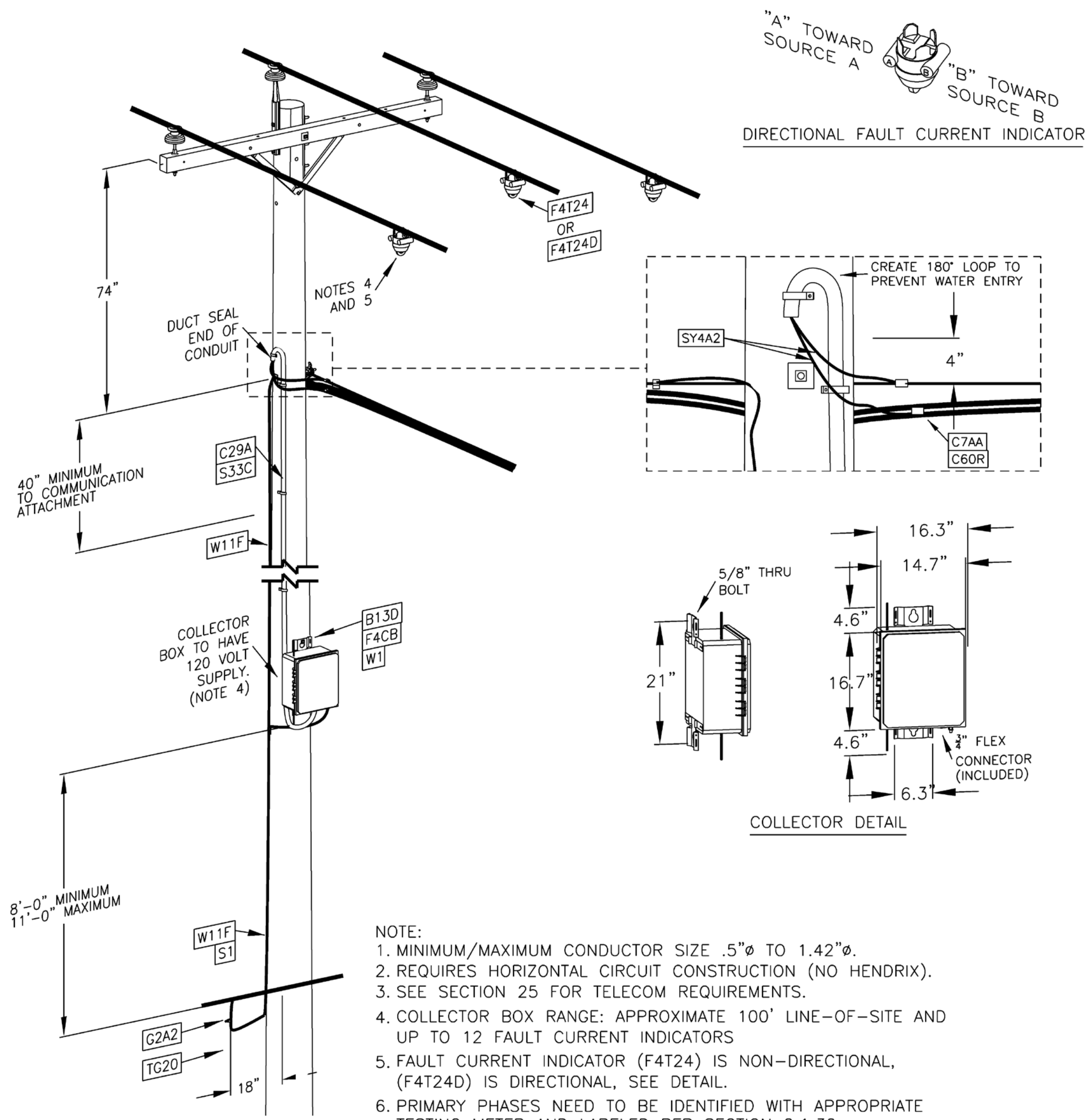
NOTE:
1. MINIMUM/MAXIMUM CONDUCTOR SIZE .5"ø TO 1.42"ø.
2. REQUIRES HORIZONTAL CIRCUIT CONSTRUCTION (NO HENDRIX).
3. SEE SECTION 25 FOR TELECOM REQUIREMENTS.
4. FAULT CURRENT INDICATOR (F3T_) IS NON-DIRECTIONAL, (F3BI) IS DIRECTIONAL, SEE DETAIL.

Designer	Drawing	Date
MPR	od12650A	6/15/20

INDICATOR - FAULT CIRCUIT - DISTRIBUTION

ISSUE	PAGE NUMBER		
7/21	12-650A	OVERHEAD CONSTRUCTION STANDARD	

7/21 Issue – Added note 6.

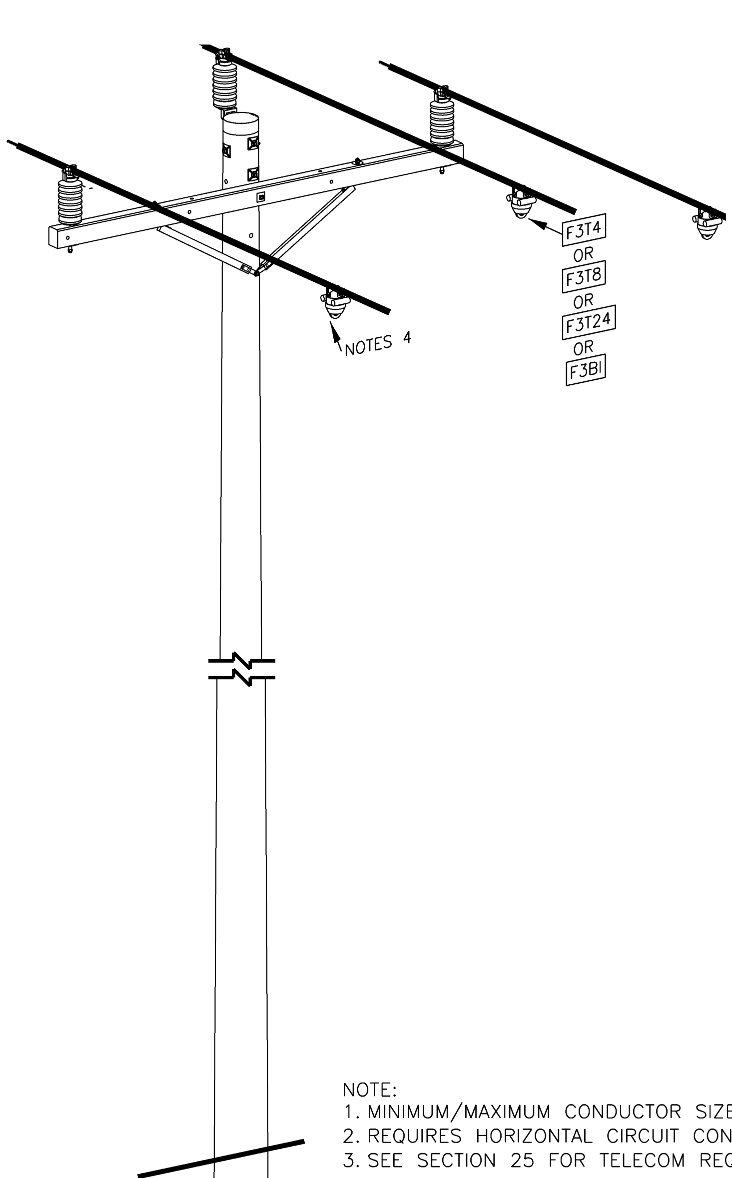


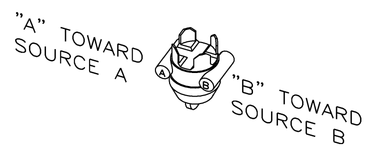
NOTE:
1. MINIMUM/MAXIMUM CONDUCTOR SIZE .5"ø TO 1.42"ø.
2. REQUIRES HORIZONTAL CIRCUIT CONSTRUCTION (NO HENDRIX).
3. SEE SECTION 25 FOR TELECOM REQUIREMENTS.
4. COLLECTOR BOX RANGE: APPROXIMATE 100' LINE-OF-SITE AND UP TO 12 FAULT CURRENT INDICATORS
5. FAULT CURRENT INDICATOR (F4T24) IS NON-DIRECTIONAL, (F4T24D) IS DIRECTIONAL, SEE DETAIL.
6. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od12650B	2/1/21

SMART INDICATOR - FAULT CIRCUIT - DISTRIBUTION

PROTECTION – OVERHEAD SUBTRANSMISSION
25kV, 35kV, 46kV





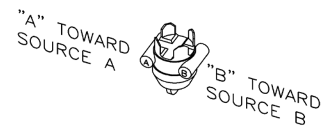
DIRECTIONAL FAULT CURRENT INDICATOR

Supersedes 7/20 issue - Updated footer title.

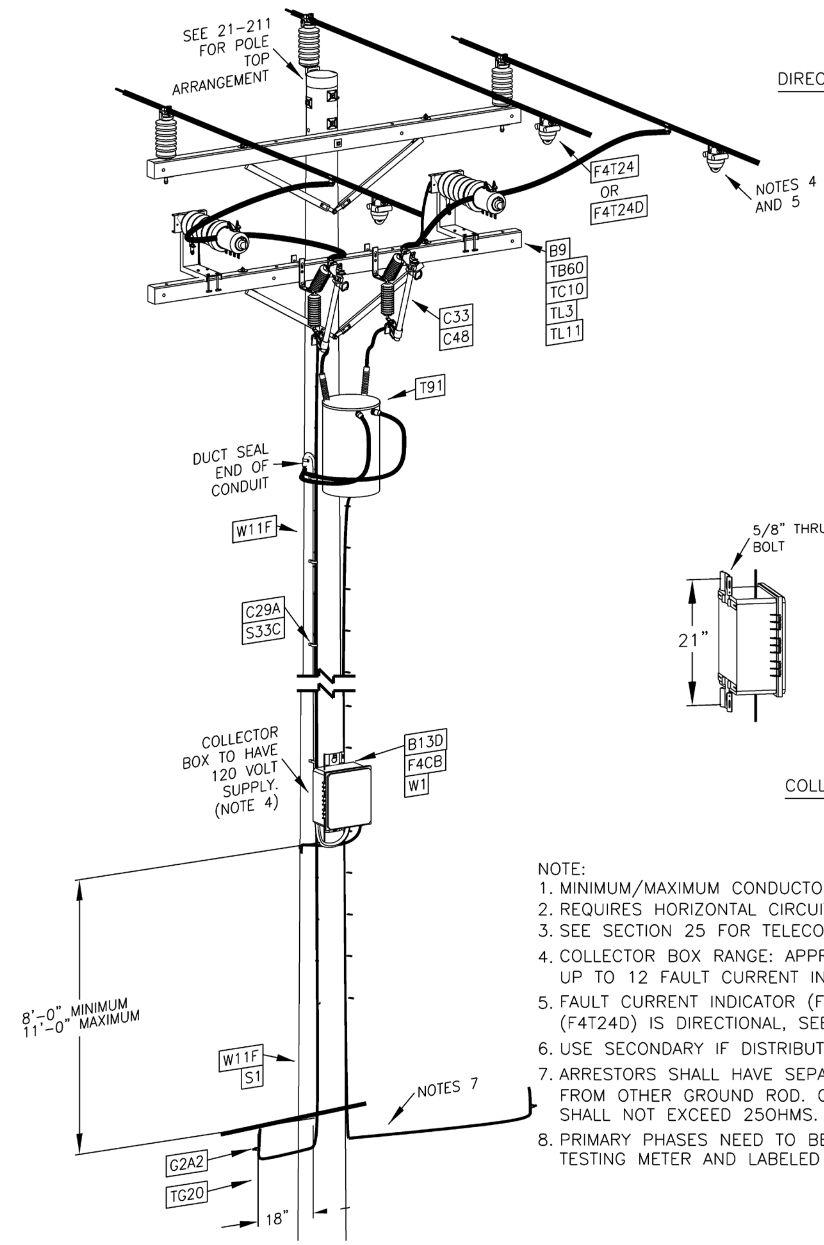
NOTE:
1. MINIMUM/MAXIMUM CONDUCTOR SIZE .5"ø TO 1.42"ø.
2. REQUIRES HORIZONTAL CIRCUIT CONSTRUCTION (NO HENDRIX).
3. SEE SECTION 25 FOR TELECOM REQUIREMENTS.
4. FAULT CURRENT INDICATOR (F3T_) IS NON-DIRECTIONAL, (F3BI) IS DIRECTIONAL, SEE DETAIL.

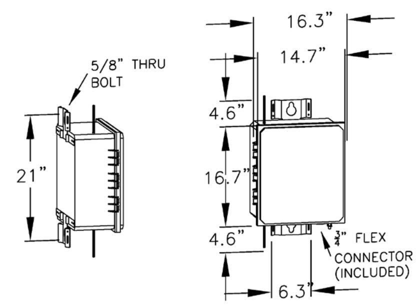
Designer	Drawing	Date
MPR	od12905A	6/15/20

INDICATOR - FAULT CIRCUIT – SUB-TRANSMISSION



DIRECTIONAL FAULT CURRENT INDICATOR





COLLECTOR DETAIL

NOTE:
1. MINIMUM/MAXIMUM CONDUCTOR SIZE .5"ø TO 1.42"ø.
2. REQUIRES HORIZONTAL CIRCUIT CONSTRUCTION (NO HENDRIX).
3. SEE SECTION 25 FOR TELECOM REQUIREMENTS.
4. COLLECTOR BOX RANGE: APPROXIMATE 100' LINE-OF-SITE AND UP TO 12 FAULT CURRENT INDICATORS
5. FAULT CURRENT INDICATOR (F4T24) IS NON-DIRECTIONAL, (F4T24D) IS DIRECTIONAL, SEE DETAIL.
6. USE SECONDARY IF DISTRIBUTION UNDER BUILD EXISTS
7. ARRESTORS SHALL HAVE SEPARATE ISOLATED 20' MINIMUM FROM OTHER GROUND ROD. GROUND RESISTANCE TO EARTH SHALL NOT EXCEED 25OHMS.
8. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

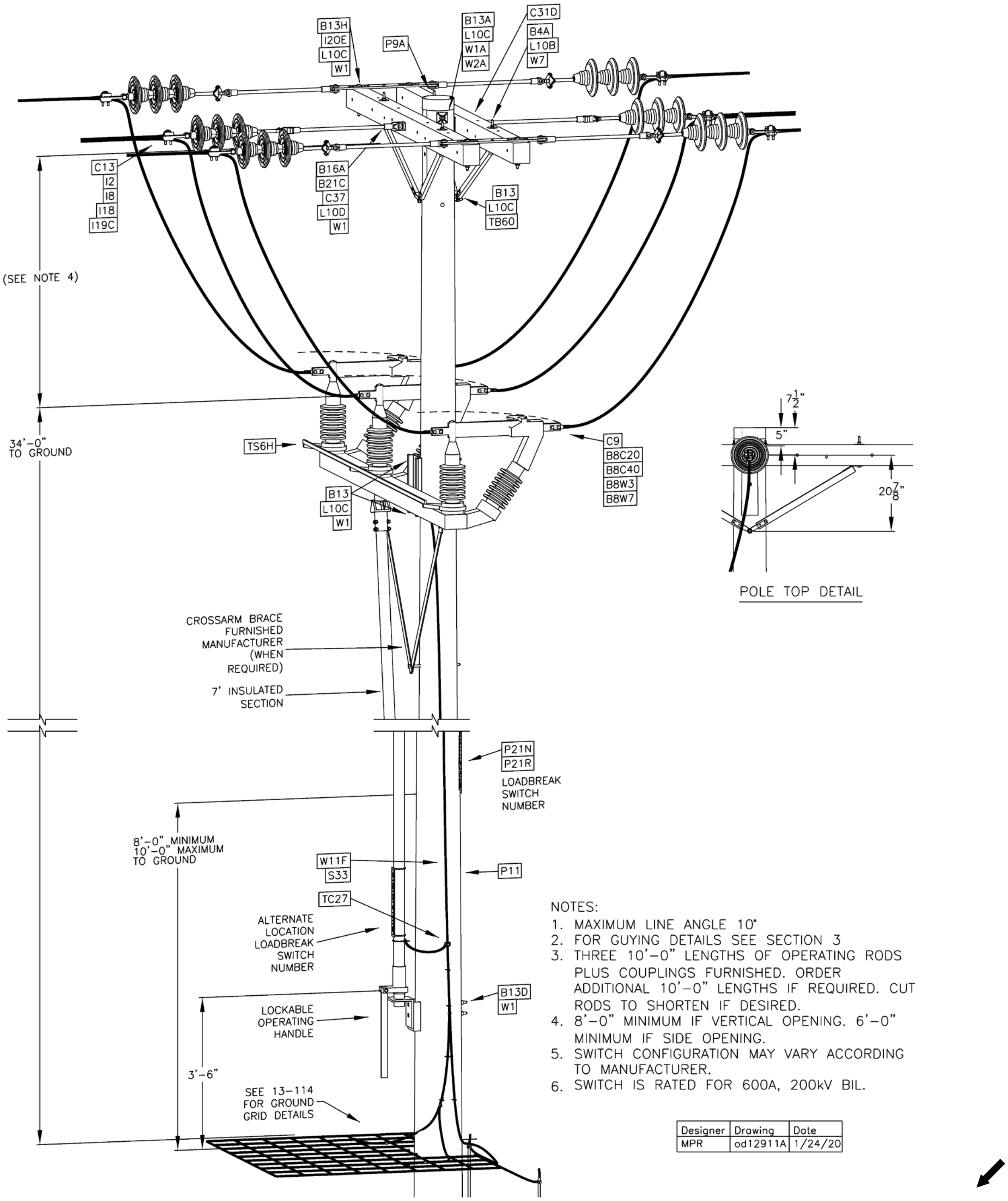
Designer	Drawing	Date
MPR	od12905B	6/18/21

7/21 Issue – Added note 8.

SMART INDICATOR – FAULT CIRCUIT – SUB-TRANSMISSION

@12-911A(V)KV(W)	POLE SW GANG OP HORZ UPR L/B (V)KV (W)
@12-911A(V)KV(W)DACCT	POLE SW GANG OP HORZ UPR L/B (V)KV (W) WITH DIST ACCOUNTING

(V) = 25, 35 (W) = 1/0, 336, 477



NOTES:
1. MAXIMUM LINE ANGLE 10°
2. FOR GUYING DETAILS SEE SECTION 3
3. THREE 10'-0" LENGTHS OF OPERATING RODS PLUS COUPLINGS FURNISHED. ORDER ADDITIONAL 10'-0" LENGTHS IF REQUIRED. CUT RODS TO SHORTEN IF DESIRED.
4. 8'-0" MINIMUM IF VERTICAL OPENING. 6'-0" MINIMUM IF SIDE OPENING.
5. SWITCH CONFIGURATION MAY VARY ACCORDING TO MANUFACTURER.
6. SWITCH IS RATED FOR 600A, 200kV BIL.

Designer	Drawing	Date
MPR	od12911A	1/24/20

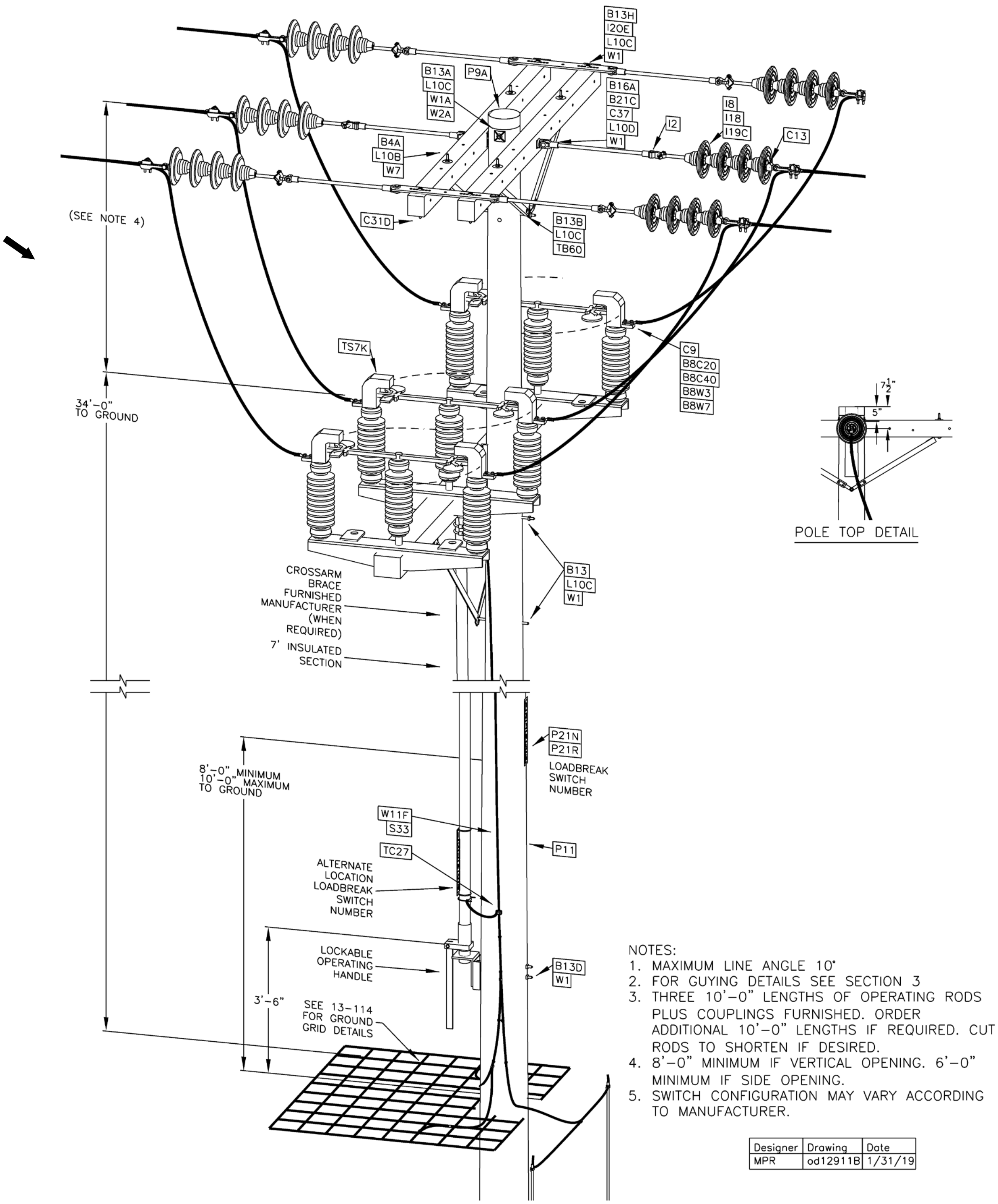
Supersedes 7/18 Issue – Added note 6

SUB-TRANSMISSION – 23-34.5kV HORIZONTAL UPRIGHT LOADBREAK

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	12-911A	7/21

@12-911B46KV(W)	POLE SW GANG OP HORZ UPR L/B 46KV (W)

(W) = 1/0, 336, 477

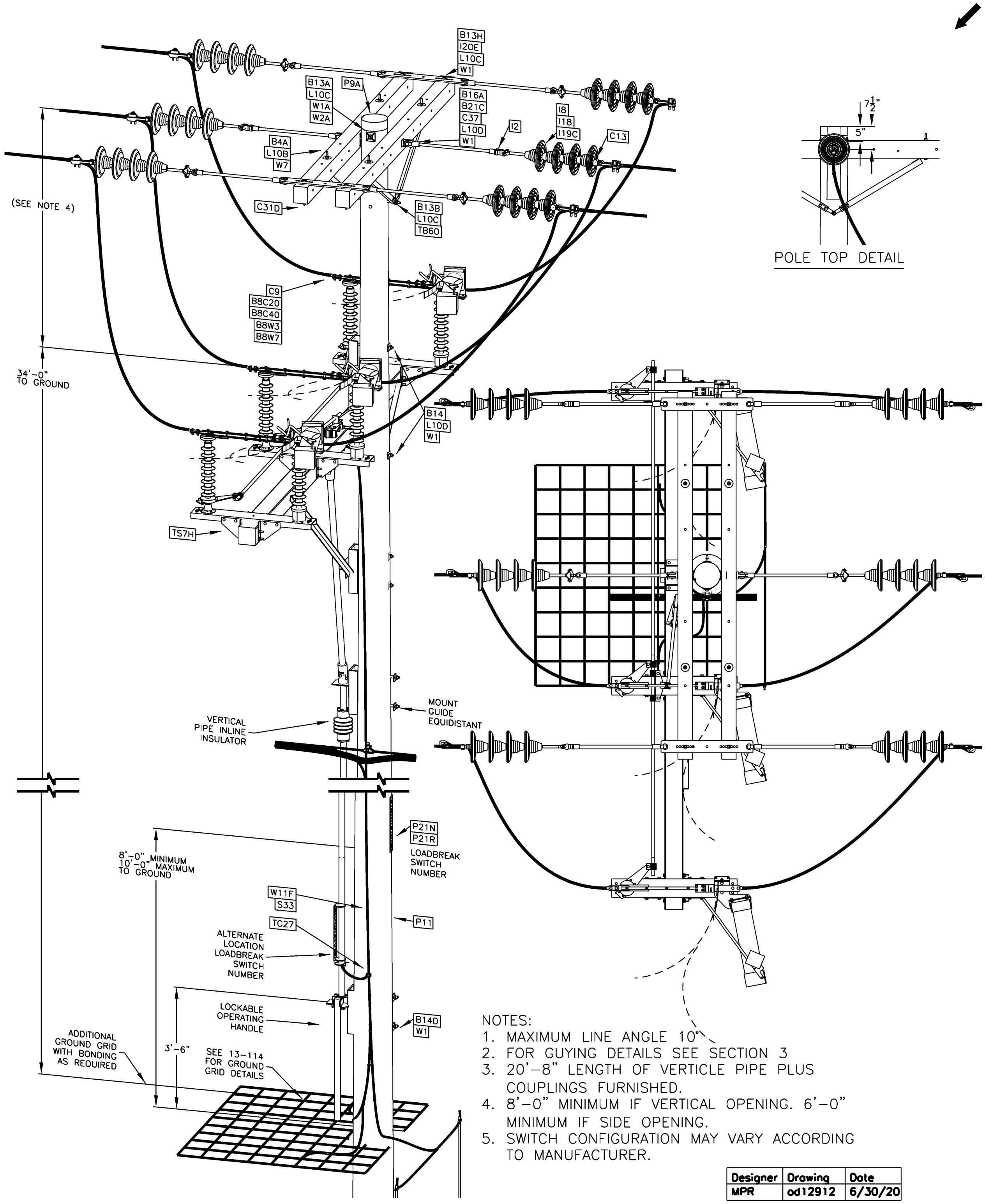


NOTES:
1. MAXIMUM LINE ANGLE 10°
2. FOR GUYING DETAILS SEE SECTION 3
3. THREE 10'-0" LENGTHS OF OPERATING RODS PLUS COUPLINGS FURNISHED. ORDER ADDITIONAL 10'-0" LENGTHS IF REQUIRED. CUT RODS TO SHORTEN IF DESIRED.
4. 8'-0" MINIMUM IF VERTICAL OPENING. 6'-0" MINIMUM IF SIDE OPENING.
5. SWITCH CONFIGURATION MAY VARY ACCORDING TO MANUFACTURER.

Designer	Drawing	Date
MPR	od12911B	1/31/19

Supersedes 7/19 Issue – Updated material IDs.

New drawing



NOTES:
1. MAXIMUM LINE ANGLE 10°
2. FOR GUYING DETAILS SEE SECTION 3
3. 20'-8" LENGTH OF VERTICLE PIPE PLUS COUPLINGS FURNISHED.
4. 8'-0" MINIMUM IF VERTICAL OPENING. 6'-0" MINIMUM IF SIDE OPENING.
5. SWITCH CONFIGURATION MAY VARY ACCORDING TO MANUFACTURER.

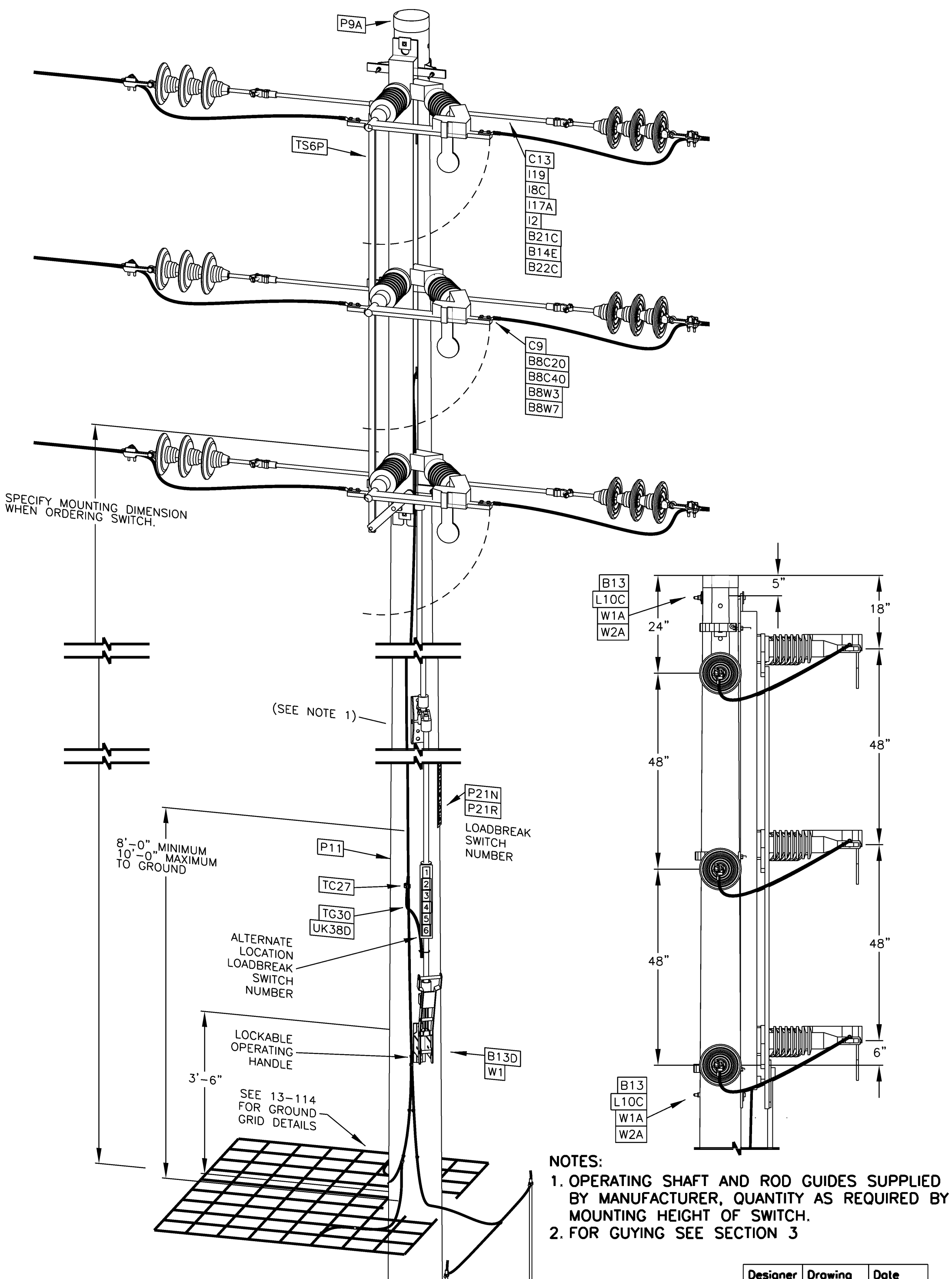
Designer	Drawing	Date
MPR	od12912	6/30/20

SUB-TRANSMISSION - 46kV LOADBREAK HORIZONTAL MOUNTED

7/19 - New Page.

@12-913A(V)KV(W)	POLE SW GANG OP PHASE OVER PHASE L/B (V)KV (W)
@12-913A(V)KV(W)DACCT	POLE SW GANG OP PHASE OVER PHASE L/B (V)KV (W) WITH DIST ACCOUNTING

(V) = 25, 35 (W) = 1/0, 336, 477, 795, 1113



NOTES:
1. OPERATING SHAFT AND ROD GUIDES SUPPLIED BY MANUFACTURER, QUANTITY AS REQUIRED BY MOUNTING HEIGHT OF SWITCH.
2. FOR GUYING SEE SECTION 3

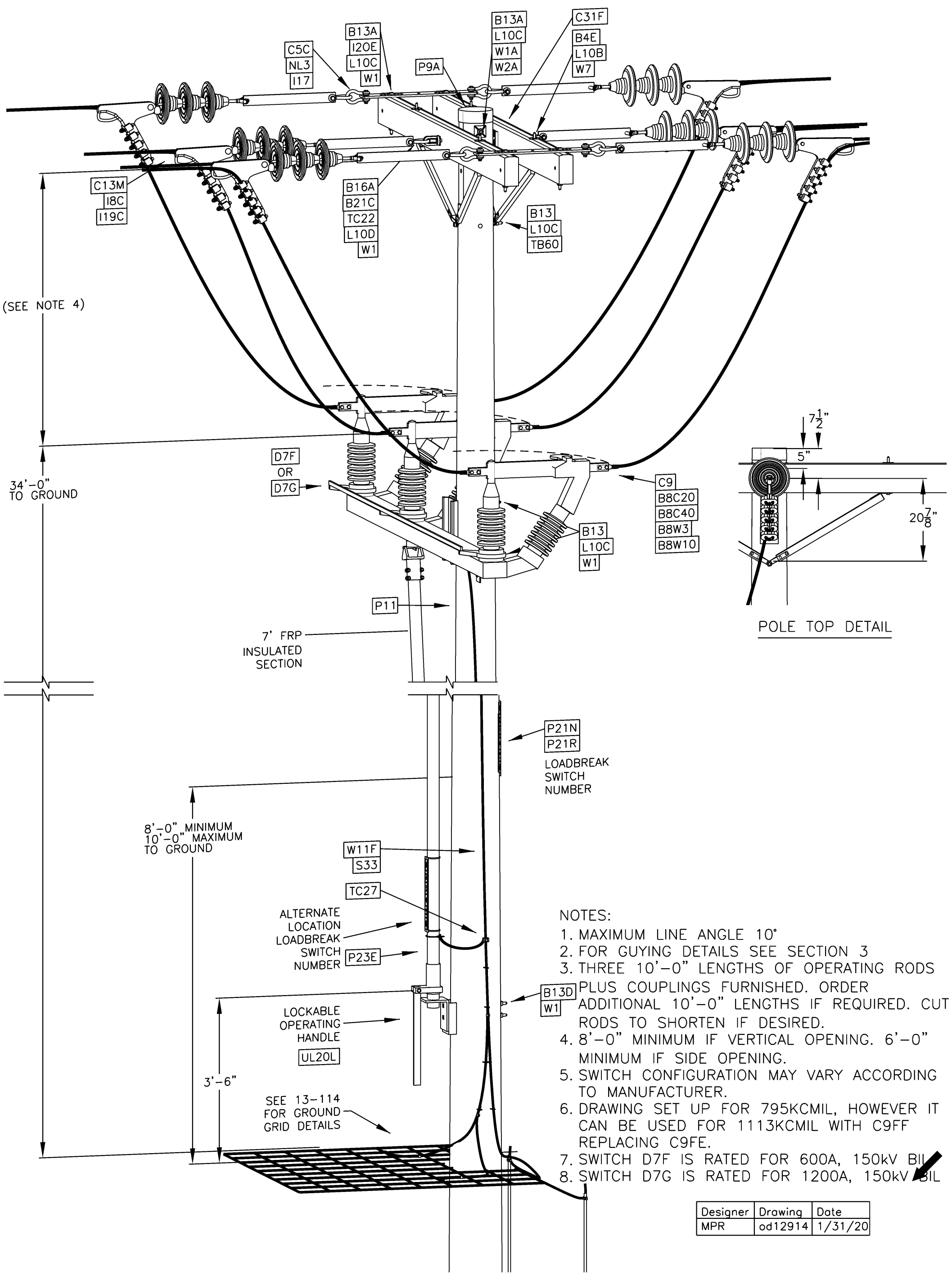
Designer	Drawing	Date
MPR	od12913A	1/31/20

Supersedes 7/18 Issue – Updated Drawing

SUB-TRANSMISSION - 23-34.5kV PHASE OVER PHASE LOADBREAK

@12-91435KVC(W)	SW LB GANG OP HORIZONTAL 35KV (W) SUB-T
@12-91435KVC(W)DACCT	SW LB GANG OP HORIZONTAL 35KV (W) WITH DIST ACCOUNTING

(W) = 795, 1113



NOTES:

1. MAXIMUM LINE ANGLE 10°
2. FOR GUYING DETAILS SEE SECTION 3
3. THREE 10'-0" LENGTHS OF OPERATING RODS PLUS COUPLINGS FURNISHED. ORDER ADDITIONAL 10'-0" LENGTHS IF REQUIRED. CUT RODS TO SHORTEN IF DESIRED.
4. 8'-0" MINIMUM IF VERTICAL OPENING. 6'-0" MINIMUM IF SIDE OPENING.
5. SWITCH CONFIGURATION MAY VARY ACCORDING TO MANUFACTURER.
6. DRAWING SET UP FOR 795KCMIL, HOWEVER IT CAN BE USED FOR 1113KCMIL WITH C9FF REPLACING C9FE.
7. SWITCH D7F IS RATED FOR 600A, 150kV BIL
8. SWITCH D7G IS RATED FOR 1200A, 150kV BIL

Designer	Drawing	Date
MPR	od12914	1/31/20

Supersedes 7/19 Issue – Added notes 7 and 8

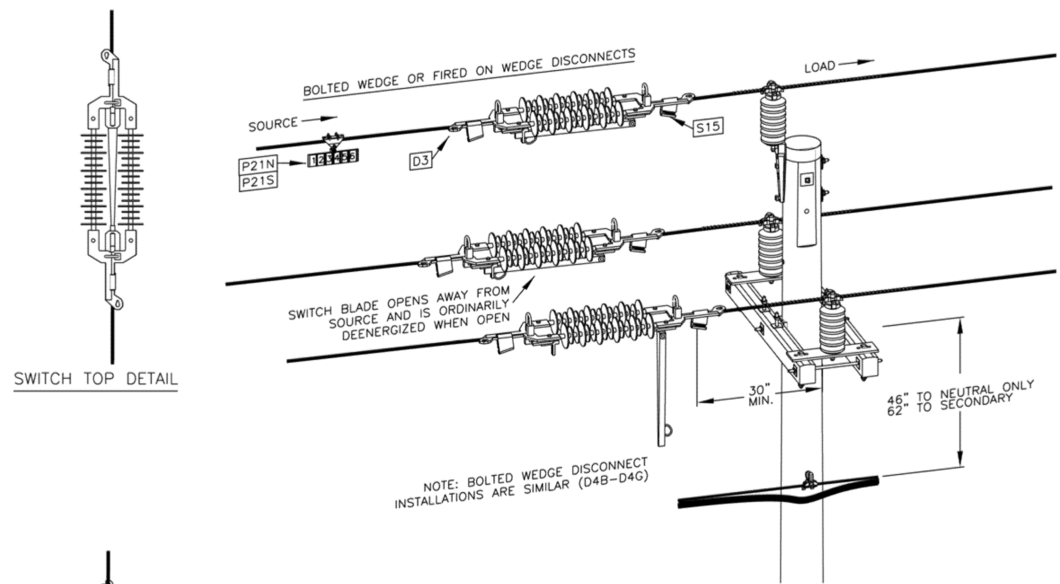
SUB TRANSMISSION - 23KV-34.5 KV LOADBREAK SWITCH FOR 795 KCMIL & 1113KCMIL CONDUCTORS

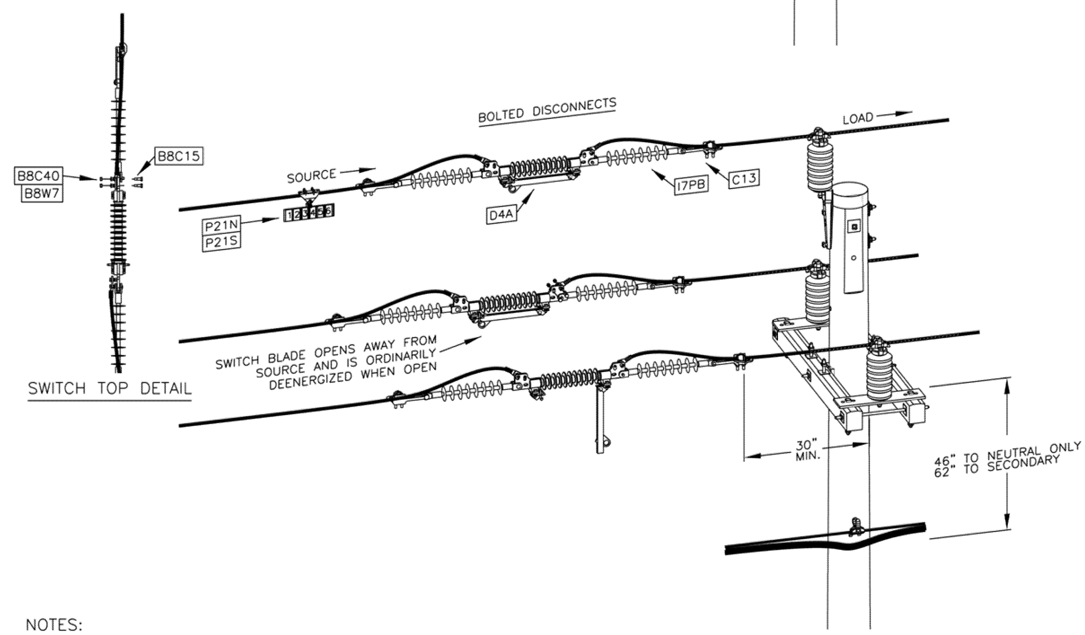
ISSUE	PAGE NUMBER		
7/21	12-914	OVERHEAD CONSTRUCTION STANDARD	ppl

CDS35K(W)AIL	DIS SW 35KV (W) AMPACT IN-LINE D3_
(W) = 1/0, 336, 477	1/0 = D3D, 336 = D3E, 477 + D3C

CDS35K(W)BOLTEDILSUB-T	DIS SW 35KV (W) BOLTED IN-LINE D4A SUB-T
(W) = 1/0CU, 2/0CU, 4/0CU, 477	

Supersedes 7/18 Issue – Corrected insulator item ID in bolted switch drawing.



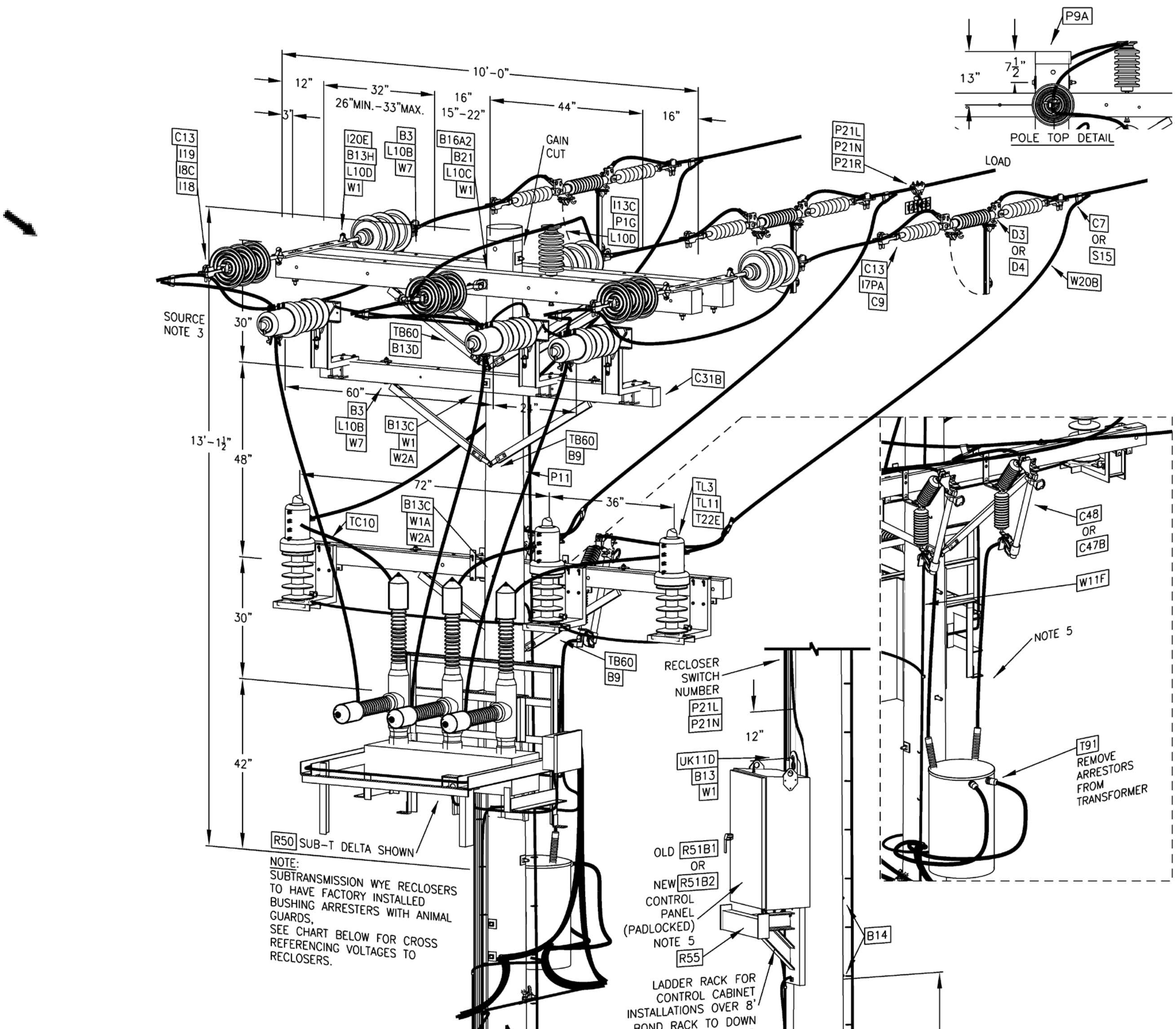


NOTES:

1. USE THE IN -LINE SWITCH ARRANGEMENT ONLY WHEN CLEARANCES WILL NOT ALLOW SWITCH INSTALLATIONS ON CROSS ARMS.
2. THIS ARRANGEMENT MAY BE APPLIED TO OTHER TYPES OF OPEN WIRE POLE TOPS INCLUDING DEAD ENDS.
3. FOR POLE TOP CONFIGURATIONS, POST STYLE INSULATORS WITH LINE GUARDS ARE REQUIRED TO REDUCE THE STRAIN UNDER SWITCH OPERATION.
4. SWITCH IDENTIFICATION SHALL BE INSTALLED ON THE CONDUCTOR MIDDLE PHASE USING THE P21S HANGER.
5. DO NOT INSTALL IN LINE SWITCHES ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20 DEGREES.
6. THE PREFERRED BOLTED SWITCH IS THE BOLTED WEDGE STYLE SWITCH (STD ITEMS D4B-D4G). USE THE D4A SWITCH FOR COPPER CONDUCTORS OR CONDUCTOR SIZES THAT ARE OUTSIDE THE RANGE OF D4B-D4G.

Designer	Drawing	Date
MPR	od12938	3/15/19

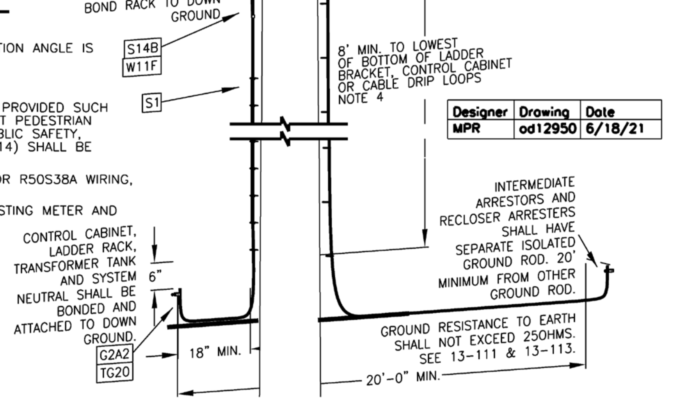
SUB – TRANSMISSION 35 KV MAX INLINE SWITCHES



NOTES:

1. DO NOT INSTALL RECLOSER ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°.
2. FUSE TWO BUSHING TRANSFORMER AT 3K.
3. SOURCE 1 POWER SUPPLY MOUNTED ON SEPERATE POLE
4. THE CONTROL CABINET MAY BE MOUNTED LOWER THAN 8 FEET PROVIDED SUCH CONTROL CABINETS DO NOT OVERHANG ROADWAYS OR OBSTRUCT PEDESTRIAN TRAFFIC, AND AFTER FULL CONSIDERATION OF WORKER AND PUBLIC SAFETY, POSSIBLE VANDALISM, AND AESTHETICS. A GROUND GRID (13-114) SHALL BE INSTALLED.
5. SEE SECTION 25 FOR TELECOM REQUIREMENTS. SEE 12-951 FOR R50S38A WIRING, AND 12-952 FOR R50S38B WIRING.
6. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

SYSTEM VOLTAGE	OLD RECLOSER	NEW RECLOSER
23,000∆	R50FS, R50GS	
34,500∆	R50FS, R50GS	R50S38B
29,900GRDY/14,400	R50FF, R50GG	
34,500GRDY/19,900	R50FF, R50GG	
23,000Y	R50FF, R50GG, R50HA	
34,500Y	R50FF, R50GG, R50HA	R50S38A

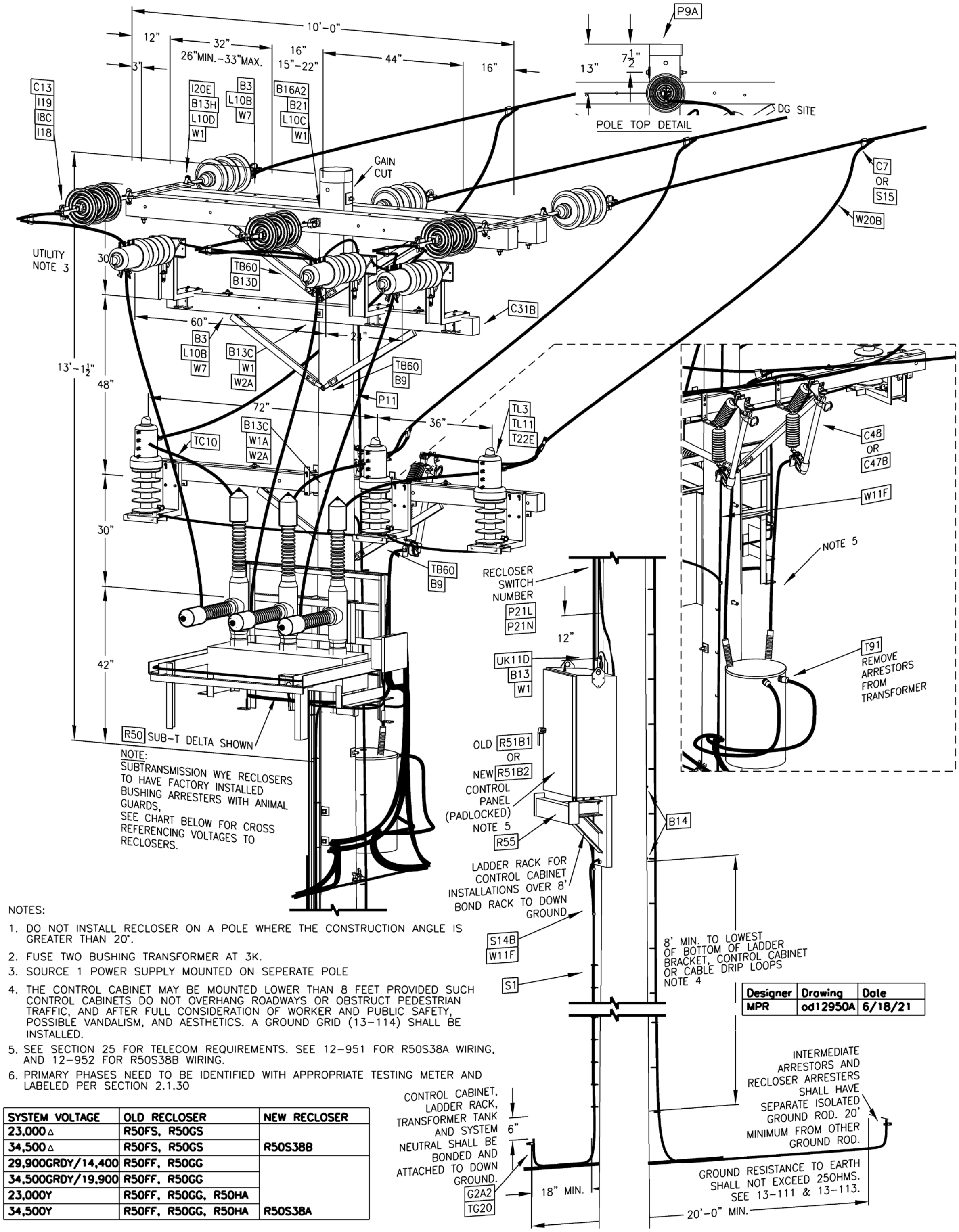


Designer	Drawing	Date
MPR	od12950	6/18/21

3Ø RECLOSER INSTALLATION 35kV WITH EXTERNAL MOUNTED PT'S

Supersedes 7/20 Issue – Revised grounding note and added pole top detail.

Supersedes 7/20 Issue – Revised grounding note and added pole top detail.



NOTE:
SUBTRANSMISSION WYE RECLOSERS TO HAVE FACTORY INSTALLED BUSHING ARRESTERS WITH ANIMAL GUARDS.
SEE CHART BELOW FOR CROSS REFERENCING VOLTAGES TO RECLOSERS.

NOTES:

1. DO NOT INSTALL RECLOSER ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°.
2. FUSE TWO BUSHING TRANSFORMER AT 3K.
3. SOURCE 1 POWER SUPPLY MOUNTED ON SEPERATE POLE
4. THE CONTROL CABINET MAY BE MOUNTED LOWER THAN 8 FEET PROVIDED SUCH CONTROL CABINETS DO NOT OVERHANG ROADWAYS OR OBSTRUCT PEDESTRIAN TRAFFIC, AND AFTER FULL CONSIDERATION OF WORKER AND PUBLIC SAFETY, POSSIBLE VANDALISM, AND AESTHETICS. A GROUND GRID (13-114) SHALL BE INSTALLED.
5. SEE SECTION 25 FOR TELECOM REQUIREMENTS. SEE 12-951 FOR R50S38A WIRING, AND 12-952 FOR R50S38B WIRING.
6. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

SYSTEM VOLTAGE	OLD RECLOSER	NEW RECLOSER
23,000Δ	R50FS, R50GS	
34,500Δ	R50FS, R50GS	R50S38B
29,900GRDY/14,400	R50FF, R50GG	
34,500GRDY/19,900	R50FF, R50GG	
23,000Y	R50FF, R50GG, R50HA	
34,500Y	R50FF, R50GG, R50HA	R50S38A

Designer	Drawing	Date
MPR	od12950A	6/18/21

3Ø RECLOSER INSTALLATION 35kV WITH EXTERNAL MOUNTED PT'S FOR DISTRIBUTION GENERATION PCC

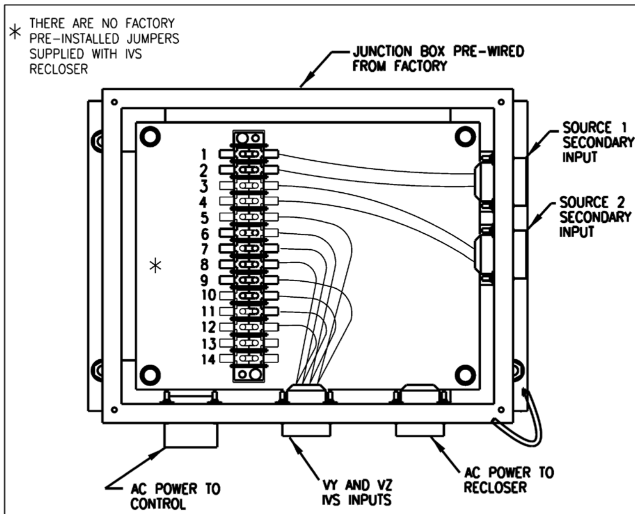
G&W VIPER-S SUBTRANSMISSION 35KV RECLOSER INSTALLATION DISTRIBUTED GENERATION PCC

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	12-950A	7/21

7/19 - New Page.

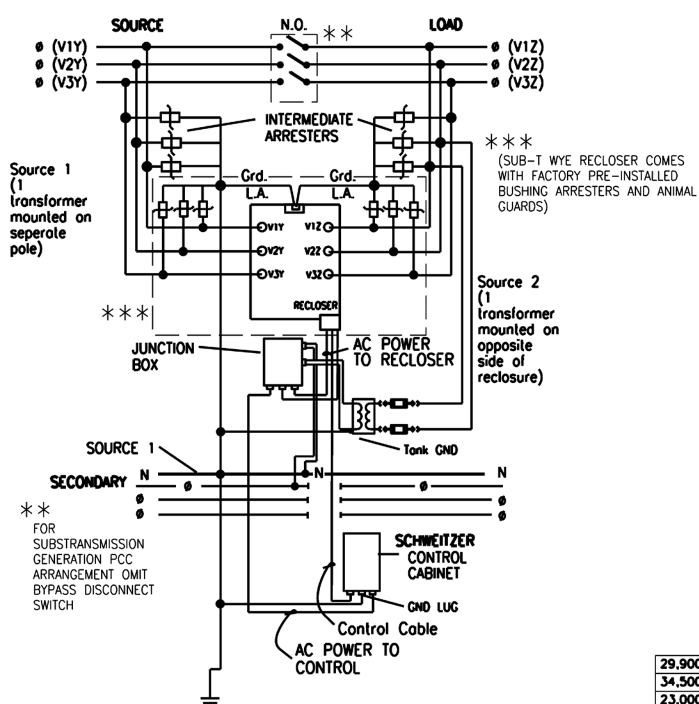
Supersedes 7/20 Issue – Added arrester note.

GENERAL WIRING DIAGRAM 38kV WITH IVS AND EXTERNAL MOUNTED PTS



JUNCTION BOX COLOR CODE			
FUNCTION	TERMINAL #	INPUTS	19 POSTION CONNECTOR
PT1 LINE SIDE	1	BLACK, S1 SECONDARY INPUT	ORANGE
	2	WHITE, S1 SECONDARY INPUT	WHITE
PT2 LOAD SIDE	3	BLACK, S2 SECONDARY INPUT	BROWN
	4	WHITE, S2 SECONDARY INPUT	WHITE W/VIOLET
VY IVS LINE SIDE PTS	5	BLACK, S1 SECONDARY INPUT	YELLOW
	6	RED, S1 SECONDARY INPUT	RED W/BLACK
	7	ORANGE, S1 SECONDARY INPUT	BLUE
	8	WHITE, S1 SECONDARY INPUT	WHITE W/BLACK
VZ IVS LOAD SIDE PTS	9	BLACK, S2 SECONDARY INPUT	BLACK
	10	RED, S2 SECONDARY INPUT	VIOLET
	11	ORANGE, S2 SECONDRY INPUT	RED
	12	WHITE, S2 SECONDARY INPUT	WHITE W/ORANGE
AC POWER	13	RED	BLUE W/BLACK
	14	WHITE	WHITE W/BLUE

120V SUPPLY CONNECTIONS	
WIRE COLOR/VOLTAGE	CONNECT TO
SOURCE 1 BLACK 120V	X1 LEG OF SOURCE SIDE SECONDARY SUPPLY
WHITE -	NEUTRAL
SOURCE 2 BLACK 120V	X1 LEG OF LOAD SIDE SECONDARY SUPPLY
WHITE -	NEUTRAL

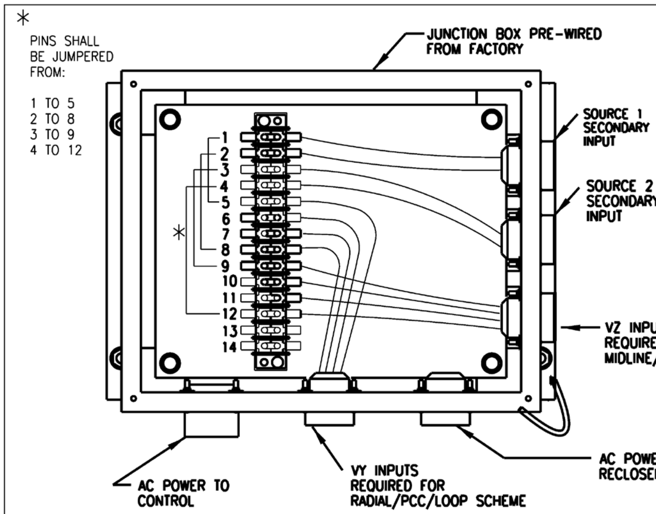


NOTE: Secondary sources shall be dedicated to power recloser. No service connections shall be made on either source or load side secondary crib.

29,900GRDY/14,400	R50FF, R50GG	
34,500GRDY/19,900	R50FF, R50GG	
23,000Y	R50FF, R50GG, R50HA	
34,500Y	R50FF, R50GG, R50HA	R50S38A

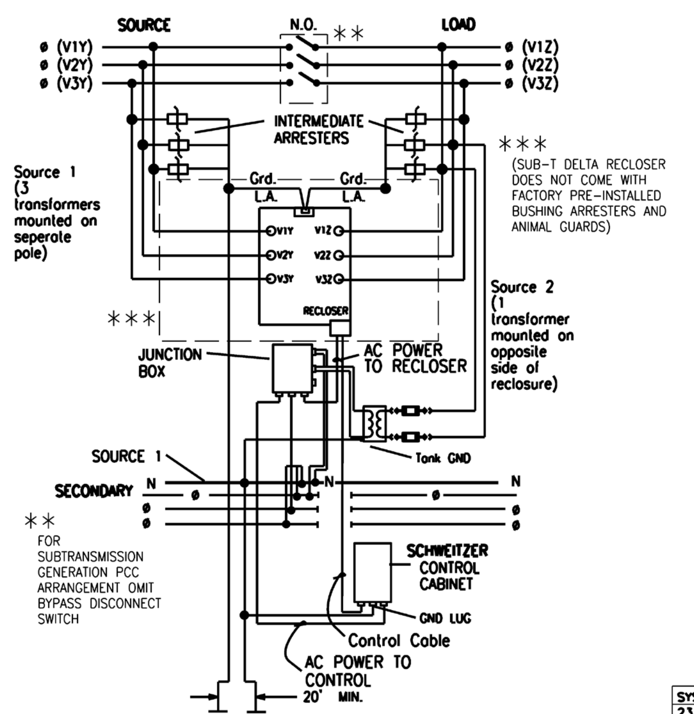
Designer	Drawing	Date
MPR	od12951	6/18/21

GENERAL WIRING DIAGRAM 38kV WITH EXTERNAL MOUNTED PTS



JUNCTION BOX COLOR CODE			
FUNCTION	TERMINAL #	INPUTS	19 POSTION CONNECTOR
PT1 LINE SIDE	1	BLACK, S1 SECONDARY INPUT	ORANGE
	2	WHITE, S1 SECONDARY INPUT	WHITE
PT2 LOAD SIDE	3	BLACK, S2 SECONDARY INPUT	BROWN
	4	WHITE, S2 SECONDARY INPUT	WHITE W/VIOLET
VY LINE SIDE PTS	5	BLACK, S1 SECONDARY INPUT	YELLOW
	6	RED, S1 SECONDARY INPUT	RED W/BLACK
	7	ORANGE, S1 SECONDARY INPUT	BLUE
	8	WHITE, S1 SECONDARY INPUT	WHITE W/BLACK
VZ LOAD SIDE PTS	9	BLACK, S2 SECONDARY INPUT	BLACK
	10	RED, S2 SECONDARY INPUT	VIOLET
	11	ORANGE, S2 SECONDRY INPUT	RED
	12	WHITE, S2 SECONDARY INPUT	WHITE W/ORANGE
AC POWER	13	RED	BLUE W/BLACK
	14	WHITE	WHITE W/BLUE

120V SUPPLY CONNECTIONS	
WIRE COLOR/VOLTAGE	CONNECT TO
SOURCE 1	
BLACK 120V	BUSHING V1Y
RED 120V	BUSHING V2Y
ORANGE 120V	BUSHING V3Y
WHITE -	NEUTRAL
SOURCE 2	
BLACK 120V	BUSHING V1Z
RED 120V	BUSHING V2Z
ORANGE 120V	BUSHING V3Z
WHITE -	NEUTRAL



***
(SUB-T DELTA RECLOSER DOES NOT COME WITH FACTORY PRE-INSTALLED BUSHING ARRESTERS AND ANIMAL GUARDS)

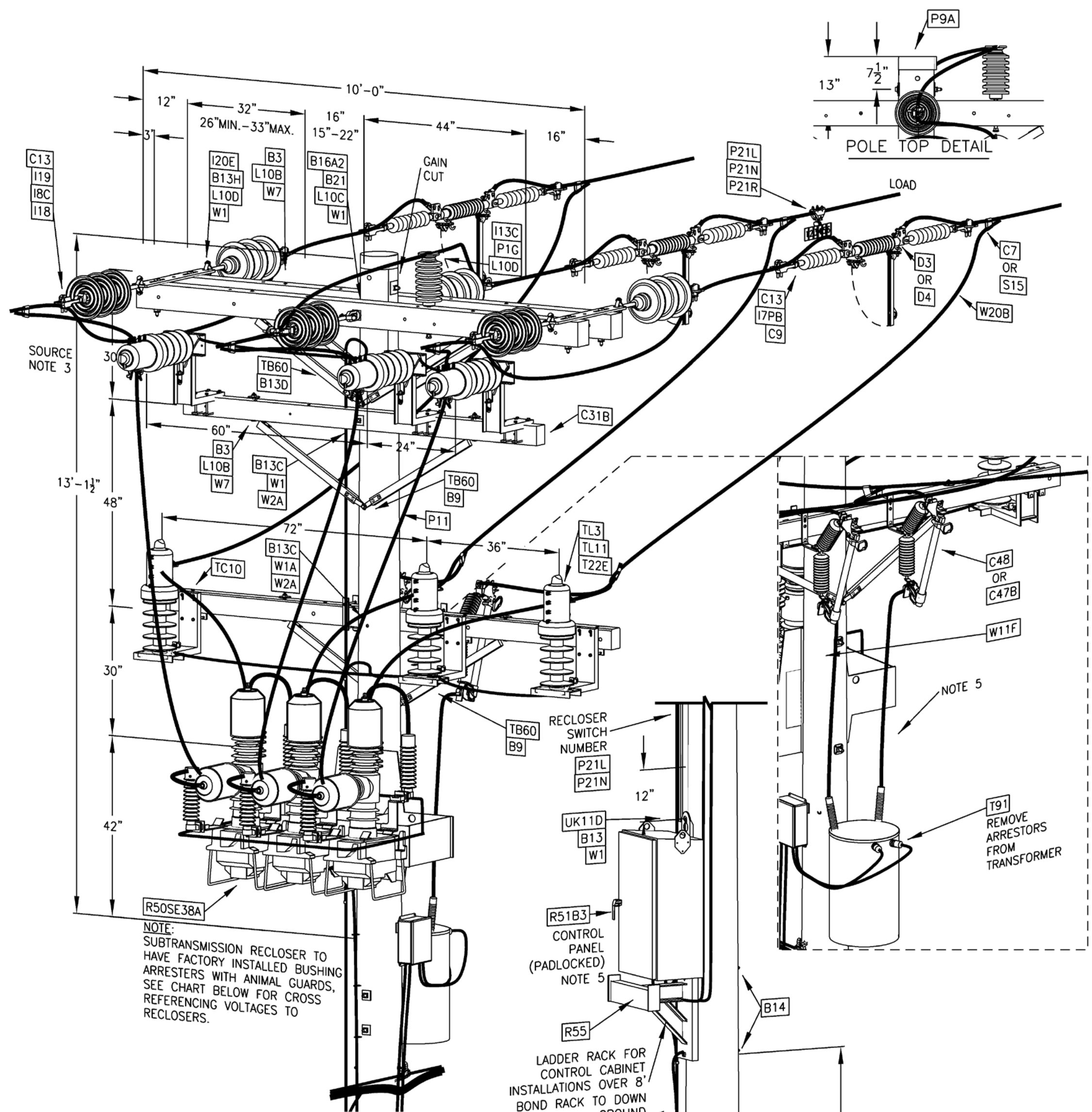
NOTE: Secondary sources shall be dedicated to power recloser. No service connections shall be made on either source or load side secondary crib.

SYSTEM VOLTAGE	OLD RECLOSER	NEW RECLOSER
23,000∆	R50FS, R50GS	
34,500∆	R50FS, R50GS	R50S38B

Designer	Drawing	Date
MPR	od12952	6/18/21

Supersedes 7/20 Issue – Added arrester note.

MU = @REC-38KV,NXT6IVS,PKG-R	Recloser, Three Phase Electronic, 800A, 38KV



Designer	Drawing	Date
MPR	od12960	6/18/21

NOTES:

1. DO NOT INSTALL RECLOSER ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°.
2. FUSE TWO BUSHING TRANSFORMER AT 3K.
3. SOURCE 1 POWER SUPPLY MOUNTED ON SEPERATE POLE
4. THE CONTROL CABINET MAY BE MOUNTED LOWER THAN 8 FEET PROVIDED SUCH CONTROL CABINETS DO NOT OVERHANG ROADWAYS OR OBSTRUCT PEDESTRIAN TRAFFIC, AND AFTER FULL CONSIDERATION OF WORKER AND PUBLIC SAFETY, POSSIBLE VANDALISM, AND AESTHETICS. A GROUND GRID (13-114) SHALL BE INSTALLED.
5. SEE SECTION 25 FOR TELECOM REQUIREMENTS. SEE 12-961 FOR WIRING.
6. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

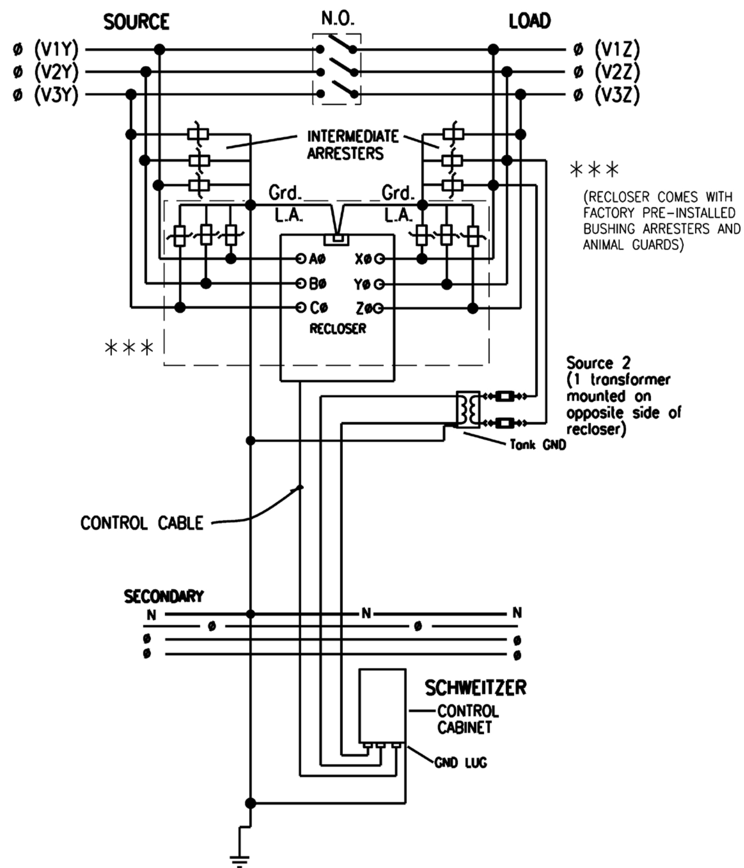
SYSTEM VOLTAGE	NEW RECLOSER
24,940GRDY/14,400	
34,500GRDY/19,900	
23,000Y	
34,500Y	R50SE38A

3φ RECLOSER INSTALLATION 35kV WITH EXTERNAL MOUNTED PT'S

EATON NOVA NX-T 3ϕ RECLOSER INSTALLATION 38KV WITH EXTERNAL MOUNTED PT'S

ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		12-960	7/21

GENERAL WIRING DIAGRAM 38kV WITH IVS AND EXTERNAL MOUNTED PTS



24,940GRDY/14,400	
34,500GRDY/19,900	
23,000Y	
34,500Y	R50SE38A

Designer	Drawing	Date
MPR	od12961	6/18/21

7/21 Issue – Aded arrester grounding note.

Version	Date	Modifications	Author(s)	Approval by (Name/Title)
9		• Updated drawings12-133B, 12-138, 12-141, 12-144, 12-330, 12-332, 12-333, 12-335, 12-335A, 12-336, 12-338, 12-350, 12-650B, 12-905B, 12-911B, 12-950, 12-950A, 12-951, 12-952, and 12-960. • Added new drawing 12-360.		
9	7/20	• Updated drawings 12-135A, 12-135B, 12-136, 12-137A, 12-137B, 12-139, 12-140, 12-144, 12-328, 12-333, 12-335, 12-335A, 12-338, 12-338A, 12-339, 12-341, 12-912,12-950, 12-950A, 12-951, and 12-952 • Added new drawings 12-9B, 12-350, 12-351, 12-650A, 12-650B,12-905A,12-905B12-960, 12-961		
8	7/19	• Added new pages 12-9A, 12-13, 12-13A, 12-146, 12-952. • Updated drawings on pages 12-10 through 12-12A, 12-14 through 12-21, 12-132, 12-133A, 12-133B, 12-138, 12-143, 12-145, 12-329, 12-330, 12-332, 12-333, 12-335 through 12-341, 12-911B through 12-912, and 12-914 through 12-952. • Deleted pages 12-335B, 12-337 through 12-337B, 12-338B, 12-340 through 12-340		
7.2	7/18	• Added note in section 12.5 E • Corrected tap connection, and standard item ID in Note 6 and CU on 12-338 • Added bolted wedge inline switches to 12-138 & 12-938 • Several drawings through section have been updated.		
7.1	7/17	• Updated page references on 12-1 • Update to capacitor fuse table 12-19 • Added DG one-lines 12-10, 12-11, 12-12 Renumbered pages. • Updated all drawings to 3D format. • Split 12-135 & 12-137 to 12-135A, 12-135B & 12-137A, 12-137B		

Version	Date	Modifications	Author(s)	Approval by (Name/Title)
7	7/16	• Added Sub T section: 12-900, 12-911A, 12-911B, 12-913A,12-914,12-938,12-950 • Added Typical DG Installation 12-10 • Updated page references on Page 12-1 • Added hanging Switch Identifier to 12-138 • Added Directional Fault Indicators Page 12-12 -12-13 • Renumbered Pages 12-14 to 12-17 • Corrected drawing side view on 12-141 and 12-144		
6	7/15	• 12.1.30 added diagram • Added new Single Phase Recloser on page 12-341 and 12.5.70 Section C on Page 12-10. • Updated Application and Operating Sequence for Cutout Mounted Reclosers on Page 12-11 • Under 12.5.70 Changed Section C to Single Phase Radial Reclosers and moved Cutout Reclosers to Section D. • Updated Drawing 12-134		
5	7/14	• Under 12.5.50 - Changed the requirement to use Loadbreak switches on all wye-delta stepdown banks and added the requirement to build all loadbreaks to meet the new Storm Hardening criteria. • Under 12.5.70 - Added the requirement to build all new reclosers on class H1 poles to meet the new Storm Hardening criteria. • Under 12.6 – added additional information on FCI's. • 12-141 – 12-145 added Storm Hardening criteria note. • 12-335, 12-338 added ladder rack detail and Storm Hardening criteria note.		
4	7/13	• Added section 12.5.70 C. – Cutout Mounted Recloser • Added 12-328 -12-332 New Standard - 1 Phase Vacuum operated cutout mounted recloser. • 12-134– Updated to match 9-435 • Added G&W Recloser Application Table • Appended Note 1 on 12-141		

Version	Date	Modifications	Author(s)	Approval by (Name/Title)
3	7/12	• 12-134 – Updated to match 9-435.- Cutouts on top crossarm. Added note to use 10' crossarms for 35kV • 12-133- Added note to use 10' crossarms for 35kV		
2	7/11	• 12-144 - New Standard - 3Φ PRIMARY SECTIONALIZING – HOOK STICK LOADBREAK SWITCH BELOW CROSSARM INSTALLATION 15 KV • 12-145 - New Standard - 3Φ PRIMARY SECTIONALIZING – HOOK STICK LOADBREAK CONDUCTOR DEADEND ON SWITCH INSTALLATION 15 KV		
1	6/10	• Under 12.5.70, Edited section to reflect 800A radial and LS recloser configurations, Removed 'Radial Recloser Control' section. • Revised notes on 12-129, 12-130, 12-134 • Added new Standards drawings 12-335, 12-336, 12-337, 12-338, 12-339, 12-340		

Supersedes 7/14 Issue – Corrected index page numbers.

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Supersedes 1/07 Issue – Clarified communication messenger bonding requirement.

13.0 GENERAL

13.0.10 Grounding

Grounding is an essential component of the overhead electric distribution system. Grounding certain types of circuits serve to protect workers and the public from being exposed to dangerous voltage levels. Grounding aids fuses and relays in system protective schemes to clear faulted circuits, and it also helps drain high voltage lightning surges from overhead distribution lines.

Grounding is usually accomplished by establishing an adequate connection to a driven ground rod, or rods, and then connecting to a continuous common neutral system if accessible.

Multiple grounds may be required to assure a low resistance connection to Earth. Driven grounds with connections to a continuous neutral are designed into an effectively grounded system. Driven grounds are also required on not effectively grounded (e.g. 4.8 kV) circuits through the secondary neutral, which effectively ties together all customer-owned grounds. Neutral secondary systems of not effectively grounded primary circuits shall not be electrically interconnected to effectively grounded circuit neutrals. An open section using a deadend insulator shall be provided between these two systems. This is to prevent transfer of neutral-to-Earth voltage onto the not effectively grounded secondary system from the effectively grounded system neutral. (The general bonding to communication company messengers may circumvent efforts to isolate some systems.)

When cutting over a not effectively grounded circuit to an effectively grounded circuit, a grounded neutral system shall be established.

While all low voltage circuits shown in these standards are grounded, some existing 480 V or 600 V not effectively grounded circuits are not solidly grounded. Certain circuits used in the oil industry, in tunnels, and other special applications are also ungrounded. Work on such circuits shall be done under the direction of persons who are familiar with the safety and lightning protection problems involved.

13.0.20 Bonding

Bonds are installed to limit the potential between two or more grounded systems. Bonds also improve lightning protection and general effectiveness of each system through multiple ground connections. Bonds are required between the Company's system neutral and grounded communication messengers on the same poles in grounded wye systems and between the Company's secondary neutral and grounded communication messengers on the same poles in delta and uni-grounded systems. There are some cases where a utility may desire an independent secondary grounding system, to limit stray voltage (in delta and uni-grounded systems)but, the grounded communication messengers must be bonded to the grounded system neutral where one exists.

13.0.30 Lightning Protection – General

Surge arresters provide a low resistance path across equipment when exposed to lightning or switching surges. This reduces the probability of insulation flash-over, or otherwise damaging equipment or lines. Arresters serve to drain the excess charge from lines, thereby reducing the probability of conductor burn down due to overvoltages that result. A metal oxide varistor (MOV) has very low resistance to the current of a high voltage surge and very high resistance to normal 60 Hz voltages. Once the voltage level returns to normal (below the maximum continuous operating voltage [MCOV]), negligible leakage current flows through the arrester.

Riser type, intermediate type, and station type arresters have lower discharge characteristics and therefore provide better equipment overvoltage protection. However, distribution type arresters do limit voltages from lightning strikes below the basic impulse level (BIL) of the equipment used on distribution circuits.
On effectively grounded systems, the arrester down-ground lead to a driven ground rod is always bonded to the system neutral and any available communication messengers, as shown on Page 13-115. On not effectively grounded primary systems, some special problems can be avoided by not interconnecting the arrester down-ground to the messengers of the other utilities.

13.1 WHAT TO GROUND

13.1.10 The following equipment and circuits shall be grounded:

A. Neutrals & Secondaries of Distribution Transformers
1. The neutral wire of each 120 V single phase, 2 wire circuit
2. The neutral wire of each 120/240 V single phase, 3 wire circuit
3. The neutral wire of each 208Y/120 V single phase, 3 wire circuit
4. The neutral wire of each 208Y/120 V or 480Y/277 V 3 phase, 4 wire circuit
5. One phase wire of each 240 V three phase circuit (has been general practice)

Each of the above secondary systems shall have at least one ground (composed of one or more driven ground rods) for each transformer, exclusive of ground connections at customers' service points.

B. Secondaries of Metering

C. Neutrals of Effectively Grounded Primary Circuits

D. Ground Terminals of Surge Arresters

E. Metallic Cable Sheaths or Concentric Neutral Conductor on Riser Poles and Metal Conduits Containing Non-Metallic Sheathed Cables

F. Spacer Cable and Lashed Cable Sheaths and Messenger Strands

G. The Cases or Frames of:
1. Apparatus such as capacitors, reclosers, regulators, transformers, etc.
2. Any piece of equipment that is within 8 feet of the Earth. (See Sections 13.2.20B and 13.2.30B)
3. Metering transformers and housing equipment.
4. Metal operating handles of switches that can be manually operated.

13.2 HOW TO GROUND

13.2.10 General

The circuits and equipment specified in Section 13.1 shall be grounded to a driven rod or rods or to another suitable connection to Earth as discussed below. Driven ground rods shall be installed in undisturbed Earth and extend at least 8 feet below grade.

On effectively grounded primary neutral systems that have at least four ground connections per rolling mile of neutral, all ground connections and bonds may be made to a single #4 or larger copper wire that is connected to a driven ground rod. Copper compression connectors shall be used for ground conductor bonds and taps. All surge arresters shall be connected to the grounding conductor through a flexible grounding lead (L6) as shown on Page 13-115.

Supersedes 1/06 Issue – Clarified 13.1.10A and updated references to 13.2.20B and 13.2.30B in 13.1.10G2.

Supersedes 1/06 Issue – Clarified ground resistance requirements, sections 13.2.20 & 13.2.30.

On not effectively grounded primary systems, the surge arrester grounding conductor and the secondary neutral grounding conductor shall be run separately to two ground rods. The two rods shall be separated by a minimum distance of 20 feet as per NESC Rule 97. To accomplish this, the secondary neutral grounding conductor can be extended to the next available pole, assuming no other grounding conductor is located on that pole, and connected to a down ground installed at that location.

A #4 soft drawn copper conductor with 45 mils HDPE cover (W11F) shall be used for most ground connections on distribution poles.

A ½ inch flexible molding shall be installed over all distribution down ground installations from finished grade up to 8 feet, for mechanical protection.

13.2.20 Effectively Grounded Systems

A. Grounding the Common Neutral

Effectively grounded common neutral systems utilize the large number of parallel connected grounds to ensure an effective low resistance to ground the common neutral. Therefore, the installation of one 8 foot rod at each required location shall be sufficient. No resistance test is required.

B. Grounding Equipment Accessible to the Public (within 8 feet of grade)

When any metal part, frame or case of the equipment listed below is installed within 8 feet of grade, such equipment shall be connected to a ground rod at the pole and the ground wire shall be connected to the common neutral. Items 1, 2, and 3 below shall also have a ground grid (see Page 13-113) when any portion is within 8 feet of grade.

1. Primary instrument transformer cabinets and primary meter housings,
2. Manually operated switch handles,
3. Control cabinets*,
4. Metal riser pipes,
5. Transformers, and
6. Regulators.

* - Control cabinets should be mounted with the lowest component (e.g. drip loop, control cable or ladder bracket) between 8 feet and 11 feet above grade. Worker access to control cabinets, including identifying locations where ladders or bucket trucks may be set up to allow worker access, shall be considered when selecting poles for the installation of equipment requiring control cabinets. After consideration of public and worker safety, potential vandalism and aesthetics, control cabinets may be mounted within 8 feet of grade with a ground rod at the pole and a ground grid (see Page 13-113). Control cabinets mounted at any height shall neither overhang roadways nor obstruct pedestrian traffic.

13.2.30 Not Effectively Grounded Systems (Delta, Ungrounded Wye or Uni-grounded Wye)

A. Grounding Secondary Neutrals or Equipment Not Accessible to the Public (8 feet or more above grade)

Not effectively grounded primary systems are dependent on individual grounds to ensure effective low resistance grounding. Where practical, individual ground resistance to earth shall not exceed 25 ohms. If the earth resistance of a single ground rod exceeds 25 ohms or is not tested, a second ground rod shall be installed, connected in parallel and at least 6 feet away from the first ground rod.

B. Grounding Equipment Accessible to the Public (within 8 feet of grade)

When the installation of any metal part, frame or equipment within 8 feet of grade is planned in a not effectively grounded system, installation and testing of ground rods prior to the installation of the equipment is recommended. This allows installation of the equipment 8 or more feet above grade to be considered before the installation of the equipment or ground grid, when required.

When any metal part, frame or case of the equipment listed below is installed within 8 feet of grade, such equipment shall be connected to a ground at the pole tested to 25 ohms or below. Items 1, 2, and 3 below shall also have a ground grid (see Page 13-113) when any portion is within 8 feet of grade. If after the installation of one ground rod and the ground grid, where required, the ground resistance is 25 ohms or below, no additional work is required. If the ground resistance is above 25 ohms, (i) install additional ground rods (each at least 6 feet away from each of the other ground rods) until the tested ground resistance is 25 ohms or below or (ii) move the equipment 8 or more feet above grade.

1. Primary instrument transformer cabinets and primary meter housings,
2. Manually operated switch handles,
3. Control cabinets*,
4. Metal riser pipes**,
5. Transformers, and
6. Regulators.

* - Control cabinets should be mounted with the lowest component (e.g. drip loop, control cable or ladder bracket) between 8 feet and 11 feet above grade. Worker access to control cabinets, including identifying locations where ladders or bucket trucks may be set up to allow worker access, shall be considered when selecting poles for the installation of equipment requiring control cabinets. After consideration of public and worker safety, potential vandalism and aesthetics, control cabinets may be mounted within 8 feet of grade with a ground at the pole tested to 25 ohms or below and a ground grid (see Page 13-113). Control cabinets mounted at any height shall neither overhang roadways nor obstruct pedestrian traffic.

** - Because metal riser pipes cannot be moved 8 or more feet above grade, they must have a tested ground resistance of 25 ohms or below. If, after installing 4 ground rods (each at least 6 feet away from each of the other ground rods), the tested ground resistance is above 25 ohms, contact Standards Engineering for additional options.

Supersedes 7/09 Issue – Page numbering updated.

13.3 BONDING

13.3.10 Bonding Between Different Parts of the Distribution System

Except as noted in Section 13.0.10 for not effectively grounded system secondaries, all grounded parts of the distribution system should be bonded together through connections to the system neutral; the effectively grounded secondary neutrals, spacer cable or lashed cable messengers; or through other grounded conductors. Guy wires on effectively grounded systems shall also be bonded to the system neutral or the effectively grounded secondary neutrals. In addition, spacer cable messengers shall be bonded to the system neutral at every pole. All messenger and phase conductor supports and fuse cutout brackets of spacer cable installations shall be bonded to the pole equipment grounding conductor.

The bonds shall be established at intervals along the line, at each location of driven ground rods which are installed not less than 4 per each rolling mile of line and at; transformers, arresters, capacitors, regulators or any other pole with a vertical grounding conductor installed.

Supersedes 7/09 Issue – Page numbering updated.

13.3.20 Bonding Between Different Systems of the Company

The system neutral and the messengers of spacer cable or lashed cables on the distribution system shall normally be bonded or connected to station grounds at all stations feeding the distribution lines. They shall also be connected to the vertical ground of transmission lines where they occupy the same pole.

13.3.30 Bonding Between the Company and Other Grounding Systems

The Company system neutral shall be bonded to the grounding system of other utilities that occupy the same pole. Such bonds shall be made only after consultation with other utilities. Where isolation of primary and secondary neutrals is done to minimize the effects of neutral-to-Earth voltages on customer facilities, separate neutrals must be established for these two systems. The communication messengers must be bonded only to the primary neutral at these locations.

13.3.40 Bonding Between Communication Company and the Company Grounding Systems

Bonds shall be installed between power company vertical grounding conductors connected to the system neutral in a multi-grounded wye system and to the secondary neutral in other types of systems and grounded communication company messengers. Page 13-115 shows typical installations. Communication messengers shall not be bonded to electric equipment or arrester ground wires that are not connected to an electric system neutral (separate equipment and arrester grounds are common in delta or uni-grounded systems). Caution should be used when line workers of either company removes their facilities and the associated bonds. Communication lines and Communication Company messengers include (by NESC definition) all lines used for public or private signal or communication service. Included are telephone, telegraph, railroad signal, fire and police alarms, cable television, and various other non-electrical supply lines.

Responsibility for bonding communication cable support messengers is as follows:

- Communication Company Attaching to Pole With an Existing Downground:
  The communication company bonds its support messenger to an existing downground on a pole (with an existing downground that is connected to: a system neutral on a multi-grounded wye system or a secondary neutral in other types of systems). This installation of the bond is done by the communication company at the communication company's expense. This includes bonding when existing communication company messengers and cables are transferred to replacement poles.

- PPL Installs a Downground on Existing Pole With Communication Attachment(s):
  When a down ground (connected to a system neutral on a multi-grounded wye system or a secondary neutral in other types of systems) is installed by PPL on an existing pole, PPL bonds the existing communication messenger(s) to the new downground wire. This downground installation and bonding of communication company support messenger(s) is done by PPL at PPL's expense.

- Communication Company Requires a Bond at Pole Without an Existing Downground:
  When newly installed communication support messengers are attached to an existing pole, must be bonded to the electric neutral at that pole, and the pole does not have an existing downground, the communication company attaches a bond wire to its newly installed support messenger and leaves it coiled up in the communication space. PPL will bring the coiled tail (bond wire) up to the supply space and bond it to the electric neutral. As shown above, the communication support messengers must be bonded to the system neutral on a multi-grounded wye system or to the secondary neutral (and not to arrester,

equipment or transformer downgrounds) in other types of systems. This bond to the electric neutral in the supply space is done by PPL at the communication company's expense. Invoicing the communication company for this bonding is done by the engineering department as part of the work order design.

13.4 EFFECTIVELY GROUNDED PRIMARY NEUTRAL

The neutral conductor of all new distribution circuits shall be effectively grounded. Where this neutral grounding has not already been accomplished, the change from not effectively grounded to effectively grounded shall be made in connection with all new construction and large maintenance jobs.

The effectively grounded system neutral shall always follow the same route as the primary conductors and be physically located on the same pole line. The system neutral must not be opened.

On any effectively grounded section of a feeder, there shall be a minimum of four grounds per rolling mile.

The effectively grounded neutral shall be installed at the secondary level on the pole. An existing phase conductor of a single phase line on crossarms may, however, be left on 5 kV insulators and converted to an effectively grounded neutral. Where secondaries exist, the secondary neutral should be grounded at the transformer pole and bonded to the effectively grounded neutral at each end of the secondary net/crib.

Similarly, an existing conductor on a vertical or "armless" type pole top may be left on 5 kV insulators and converted to an effectively grounded neutral if there are no transformers or secondaries on the pole. If a transformer is installed on a vertical or armless pole, or if a secondary is installed on any pole, the effectively grounded neutral shall be relocated to the secondary position.

13.5 COMMON NEUTRAL

Common neutral exists wherever the same conductor serves as the neutral for both the primary and secondary circuits. Only one vertical ground wire should be installed on a pole with a common neutral.

The Common neutral shall meet the size requirement in Section 9.1.3. A common neutral shall not be used as the grounded phase conductor of a not effectively grounded secondary. It shall, however be bonded to this conductor. The secondary grounded neutral of a not effectively grounded primary circuit shall be isolated from any effectively grounded system neutral as stated above in Section 13.0.10.

Every effort should be made to preserve the continuity of the system neutral and to establish the best possible connections between the neutral and Earth. It shall meet the grounding requirements in Section 13.4 above and shall be bonded to grounded equipment whenever practicable.

13.6 LIGHTNING PROTECTION

13.6.10 General

Surge arrester protection shall be provided for capacitors, reclosers, regulators, transformers, and other equipment as prescribed in section 13.6.30 below. Surge arresters are also used to improve system reliability as prescribed in section 13.6.40 below.

When any silicon carbide (SiC) porcelain arrester is replaced with an MOV polymer arrester in a cluster mount or riser pole configuration, all SiC porcelain arresters are to be removed and replaced with MOV polymer arresters.

To obtain the proper equipment protection and arrester operation, the following practices are recommended:

A. Surge arresters shall be installed on the same pole with the equipment to be protected.
B. Surge arresters shall be connected to a driven ground at the same pole as the arrester.

Supersedes 7/08 Issue – Page numbering updated.

C. Both the line side and the ground side arrester leads shall be kept as short and as straight as possible. Long leads will significantly reduce the margin of protection provided by the arrester. For the combined line and ground lead length, normal practice is to add 1.6 kV per foot to the specified arrester discharge voltage at the discharge current level selected for coordination.

D. When installing MOV arresters, the ground lead shall be connected first. Since MOV arresters continuously conduct a small amount of current, a slight arc may be drawn when connecting the line side of the arrester.

E. When disconnecting MOV arresters, always disconnect the ground lead last. An MOV arrester should have the line end touched to the pole ground to discharge it immediately after removal since it can retain a small electrical charge for a few minutes. After removing a MOV arrester with an intact disconnector from service a restraining device should be installed to comply with U.S. Department of Transportation regulations.

F. **WARNING:** A failed arrester with a blown disconnector shall be treated as energized at full line potential at both ends of the arrester.

G. One should avoid dropping an MOV arrester. The internal charge in the disconnector could be discharged.

13.6.20 Selection Criteria

It is necessary to select the proper arrester and install it in the correct location. An improperly selected or applied arrester will not provide the desired protection to the distribution system and can lead to arrester failure and poor reliability performance. For proper selection, it is necessary to determine the following:

A. Operating voltage of the circuit
Note: No part of the circuit with connected surge arresters should normally experience voltages greater than 1.05 per unit of the nominal circuit operating voltage.

B. Basic impulse level of the equipment to be protected

C. Connection of equipment to the circuit
WARNING: Some equipment may be utilized on circuits of the same voltage class but with those voltage classes having different degrees of grounding. Be sure that the arresters specified or supplied with the equipment are of the correct rating for the specified circuit.

D. Circuit grounding type
Determine whether the circuit is effectively grounded or not effectively grounded. Engineering shall confirm circuit grounding if necessary. Effectively grounded circuits have an X0/X1 ratio of 3 or less while not effectively grounded circuits have an X0/X1 ratio of greater than 3. If, via permanent field switching, equipment has the potential to lose its effective grounding and remain energized from a not effectively grounded circuit, equipment BIL requirements and arrester application should be reviewed.

After determining the above criteria, select the proper arrester from Table 1 in Section 13.7.

13.6.30 Protecting Equipment With Surge Arresters

To protect equipment MOV surge arresters shall be installed in accordance with the following, utilizing properly rated arresters from Table 1, in Section 13.7. Actual physical arrester locations on circuits and equipment are shown in specific standard sections for the construction involved.

A. Primary Wire Transitions

Arresters are required at all junctions from bare conductors to anything other than bare conductor. This includes transitions from bare conductor to covered wire, tree wire or spacer cable. For purposes of this requirement, fabric-covered conductors (sometimes called “weatherproof” conductors) shall be considered bare conductors. These arresters protect the insulation on the covered conductor, tree wire or spacer cable from damage.

These arresters shall be placed at the pole with the wire transition and should be as close to the wire transition as possible.

Surge arresters are not required because of transitions between conductors of different materials (aluminum to copper). Surge arresters are not required because of transitions between different types or thicknesses of covering on conductors.

B. Primary Risers

Riser type surge arresters shall be installed at the transition from underground cable to open wire (bare or tree wire) or spacer cable circuits. Arresters shall be installed on the termination side of the closed disconnects immediately adjacent to the riser termination. The grounding conductor from the arrester shall be bonded to the concentric neutral or metallic sheath of the underground cable as close to the termination as possible, and to a driven ground at that pole. On grounded wye circuits, it shall also be connected to the system neutral of the overhead circuit.

C. Lashed Aerial Cables

Riser type surge arresters shall be installed at the transition from lashed aerial cable to open wire (bare or tree wire) or spacer cable circuits. Arresters shall be installed on the termination side of the closed disconnects immediately adjacent to the riser termination. The grounding conductor from the arrester shall be bonded to the concentric neutral or metallic sheath of the underground cable as close to the termination as possible, and to a driven ground at that pole. On grounded wye circuits, it shall also be connected to the system neutral of the overhead circuit.

D. Transformers

All overhead transformers shall be protected by surge arresters. Surge arrester location, and grounding and bonding methods, for overhead transformers installed on standard effectively grounded and not effectively grounded circuits are shown on Page 13-112. The arrester shall be connected to the transformer side of the primary fused cutout for conventional transformers.

> **EXCEPTION** – Floating wye - delta connected transformer banks shall not use tank mounted arresters. Surge arresters shall be crossarm mounted on the same pole as the transformer bank and connected to the source side of the fused cutouts. This connection avoids exposure of the arresters to possible overvoltages when a fuse cutout is open.

In grounded wye systems, the transformer tank and arrester ground leads shall be connected to the common neutral. In other systems, including delta systems, the transformer tank and arrester ground leads shall be isolated from the secondary neutral.

Step-down and step-up transformers, shall have surge arresters installed on all phase conductors on both the high voltage and low voltage sides of the unit. When the arresters are mounted separately (not installed on the transformers), they shall be connected between the fused cutouts or disconnect switches and the transformer bushings, as close to the transformer bushing as practical.

> **EXCEPTION** – Floating wye - delta connected transformer banks shall not use tank mounted arresters. Surge arresters shall be crossarm mounted on the same pole as the transformer bank and connected to the source side of the fused cutouts. This connection avoids exposure of the arresters to possible overvoltages when a fuse cutout is open.

Supersedes 7/08 Issue – Revised section 13.6.30 to clarify arrester application requirements.

E. Regulators

Regulators shall have tank mounted surge arresters installed on the source and load bushings. The manufacturer may also provide a bypass arrester between the source and load bushings depending upon design.

F. Primary Metering Equipment

Primary metering equipment shall be protected with surge arresters.

G. Capacitors

Capacitors shall have surge arresters. Arresters shall be connected between the fused cutouts or other switch and the capacitor bushings. Arrester connections should be made as short and as straight, and as close to the bushings, as possible. New capacitor banks are supplied with arresters already mounted on the capacitor frame.

Supersedes 7/10 Issue – Added Tripsavers to 13.6.40(A)

13.6.40 <u>Improving Reliability With Surge Arresters</u>

Arresters are generally required at open points in the system and at switching points that may become open point under some operating conditions. Open points in lines become reflection points for lightning surges, producing a voltage doubling of the surge at that location. This will frequently cause insulation flashovers and result in poor reliability.

A. Cutouts with Fuses or Cutout Mounted Reclosers (Tripsavers)

For new construction, arresters are required on n the load side of cutouts with fuses or cutout mounted reclosrs. Where the cutout is installed on a new pole, these arresters shall be installed on that pole. Where the cutout is being installed on an existing pole, this arrester requirement may be met in the following ways listed in order of preference:

- Existing arresters on the load side of the cutout on any pole within 300’ of the cutout will fulfill the requirement,
- New arresters may be installed on the pole with the cutout, and
- New arresters may be installed on an adjacent pole on the load side of the cutout within 300’ of the cutout.

B. Airbreak and Loadbreak Switches

Surge arresters are required on all phase conductors on both sides of the switches.

For new installations, phases should be deadended above the switch frame with the arresters mounted on the switch frame. Where phases are deadended on the switch frame, arresters shall be installed on the next pole on the source and load side of the switch. If there are already surge arresters installed on all phase conductors within 300 feet of the switch, additional surge arresters on that side of the switch are not required.

When installing arresters at an adjacent pole, crossarm mounting is preferred. Where crossarm mounting of the arresters is not possible, mount arresters on a three phase fiberglass equipment mount.

It is important to install surge arresters on all three phases so that all phases experience the same level of protection. Otherwise, flashover of the lightly protected phases might occur.

Note: For existing normally closed airbreak or loadbreak switches without arresters, install arresters on both sides of the switch when the switch is to become normally open. If arrester installation is not convenient at the switch pole location, arresters should be installed on all phase conductors on the adjacent poles.

C. Disconnect Switches

Surge arresters are required on all phase conductors on both sides of the disconnect switches.

Arresters shall be installed on the next pole on the source and load side of the disconnect switches. If there are already surge arresters installed on all phase conductors within 300 feet of the disconnect switches, additional surge arresters on that side of the disconnect switches are not required.

When installing arresters at an adjacent pole, crossarm mounting is preferred. Where crossarm mounting of the arresters is not possible, mount arresters on a three phase fiberglass equipment mount.

It is important to install surge arresters on all three phases so that all phases experience the same level of protection. Otherwise, flashover of the lightly protected phases might occur.

Note: For existing normally closed disconnect switches without arresters, install arresters on both sides of the disconnect switches when the disconnect switches are to become normally open. If arrester installation is not convenient at the disconnect switch pole location, arresters should be installed on all phase conductors on the adjacent poles.

D. <u>Line Reclosers and Sectionalizers</u>

Line reclosers and sectionalizers shall have arresters installed on both the source and load side using the mounting provisions provided. New line reclosers are supplied with arresters already installed on the recloser. Surge arrester connections should be made as short, straight and close to the bushings as possible.

E. End of Line

Arresters shall be installed on each phase at end of line deadends. Where there is equipment with surge arresters on that pole, additional surge arrester(s) are not required for any phase that already has a surge arrester at that pole.

13.6.50 <u>Miscellaneous</u>

A. Customer Equipment

Surge arrester protection for customer owned equipment served at the distribution voltage is the customer's responsibility. The customer shall be advised of the degree of surge protection that may be incidentally provided by the Company, but shall be responsible for arranging and installing any additional protection requirements.

B. Generators

Any generators connected to the distribution system may impact arrester application. This connection must undergo a Company engineering review.

Supersedes 7/08 Issue – Added new sections 13.6.40 & 13.6.50 to clarify arrester application requirements.

13.7 SURGE ARRESTER APPLICATION TABLE

Surge arresters shall be selected based upon the application criteria below.

Table 1

<table>
<tr><th>PRIMARY CIRCUIT VOLTAGE</th><th>ARRESTER DUTY CYCLE RATING (kV)</th><th>MAX. CONTINUOUS OPERATING VOLTAGE</th><th>STANDARD ITEM NUMBER (HEAVY DUTY TYPE)</th><th>STANDARD ITEM NUMBER (RISER TYPE)</th></tr>
<tr><td>2400 Delta
4160 Grd Y/2400</td><td>3</td><td>2.55 kV</td><td>L3A</td><td rowspan="2">L3DR</td></tr>
<tr><td>4160 Delta
4800 Delta
8320 Grd Y/4800
7200 Delta</td><td>10</td><td>8.40 kV</td><td>L3D</td></tr>
<tr><td>12470 Grd Y/7200
13200 Grd Y/7620
13800 Grd Y/7960
11000 Delta</td><td>12</td><td>10.2 kV</td><td>L3E</td><td>L3ER</td></tr>
<tr><td>11500 Delta
12000 Delta
13200 Delta
13800 Delta</td><td>15</td><td>12.7 kV</td><td>L3F</td><td>L3FR</td></tr>
<tr><td>22900 Grd Y/13200
23900 Grd Y/13800
24940 Grd Y/14400</td><td>21</td><td>17.0 kV</td><td>L3G</td><td>L3GR</td></tr>
<tr><td>34500 Grd Y/19900
22900 Delta
23000 Delta
23900 Delta
34500 Delta</td><td>27</td><td>22.0 kV</td><td>L3J</td><td>L3JR</td></tr>
</table>

Supersedes 7/09 Issue – Page numbering updated.

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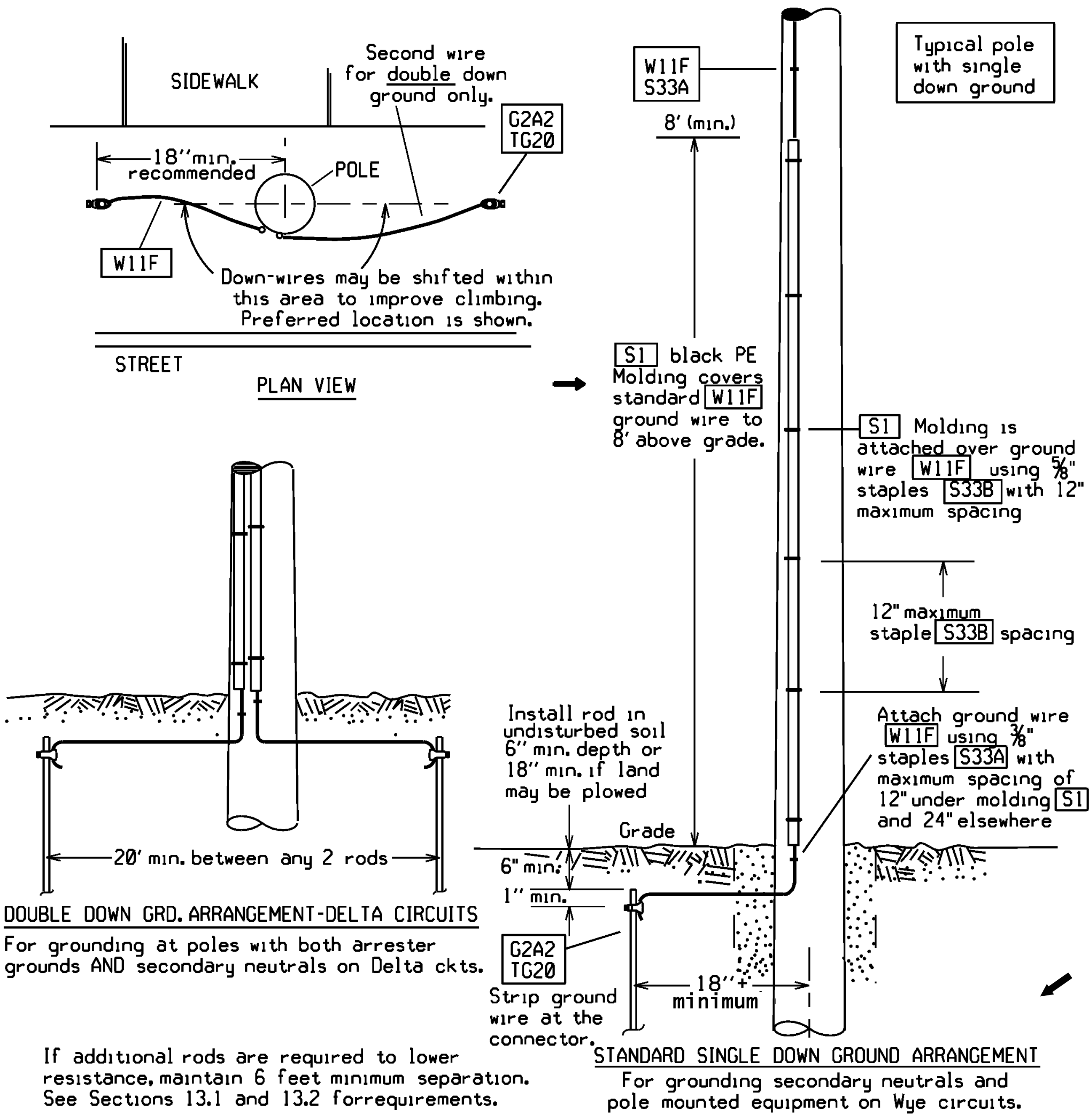
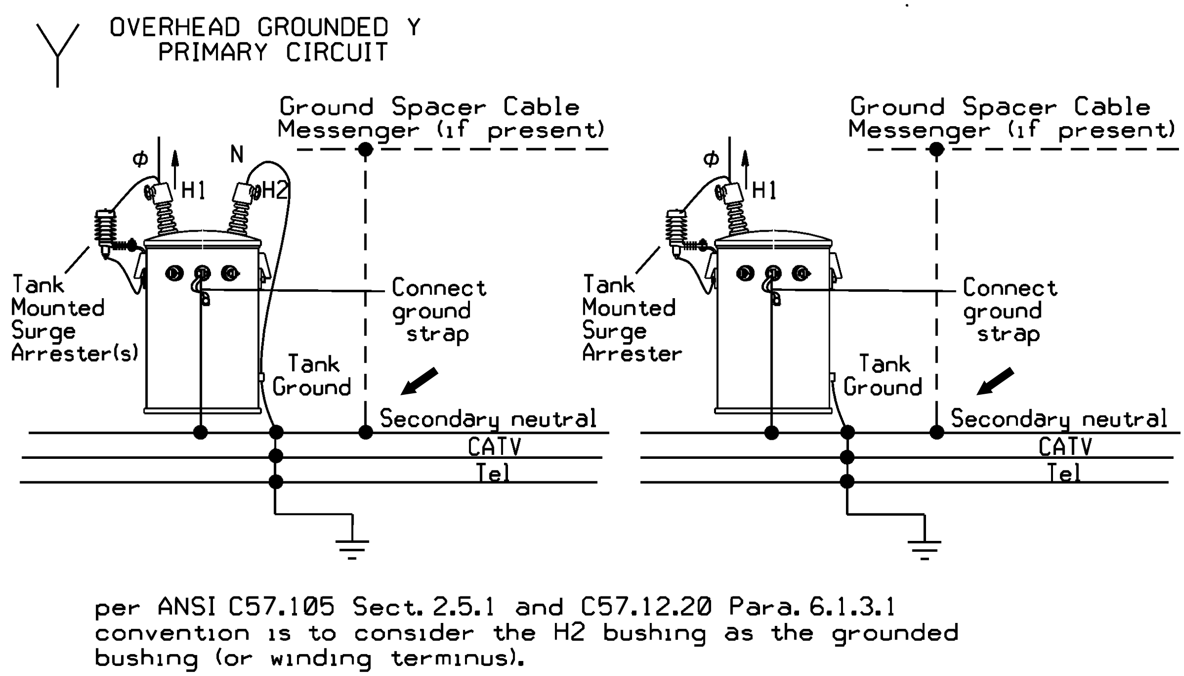
Supersedes 7/15 Issue – Revised title text to match index.

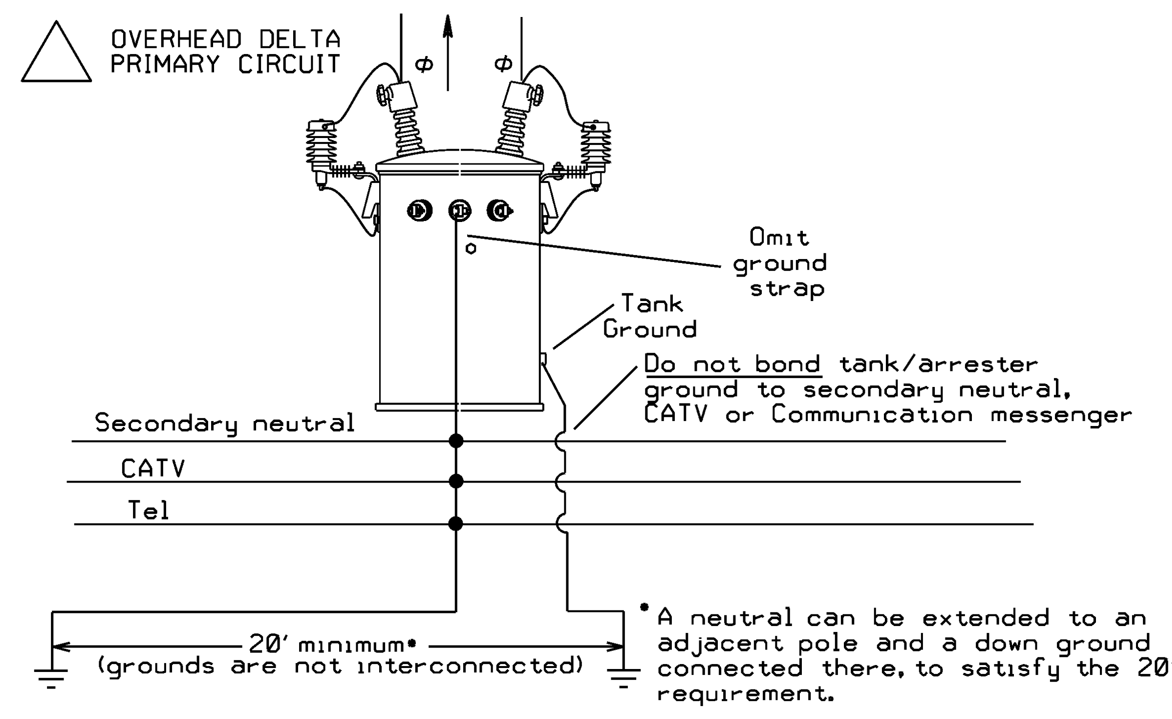


NOTES: 1. Cover down ground with (S1) PE Molding for the first 8' above grade.
2. Use ground rod driving head when installing ground rods.
3. Install rods into undisturbed soil and maintain 6' min. spacing between any 2 rods.
4. Only one 8' driven ground rod is required if the ground wire is interconnected to a multigrounded neutral and the pole has no equipment within 8' of grade (see 13.2.10).
5. For typical overhead transformer grounding, see Drawing 13-112.

GROUNDING FOR NEUTRALS AND EQUIPMENT			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 13-111	ISSUE 7/20



GROUNDING OF OVERHEAD TRANSFORMERS ON GROUNDED WYE CIRCUITS
(Except 3Φ Delta Secondary Services -i.e. Fig. 4, Dwg. 14-304)



GROUNDING OF OVERHEAD TRANSFORMERS ON UNGROUNDED WYE AND DELTA CIRCUITS

Supersedes 7/08 Issue – Modified arrester and tank grounds for grounded-wye transformers.

CU = CSVG	Single Vertical Ground
CU = CDVG	Double Vertical Ground
CU = CDVGG	Grounding Grid

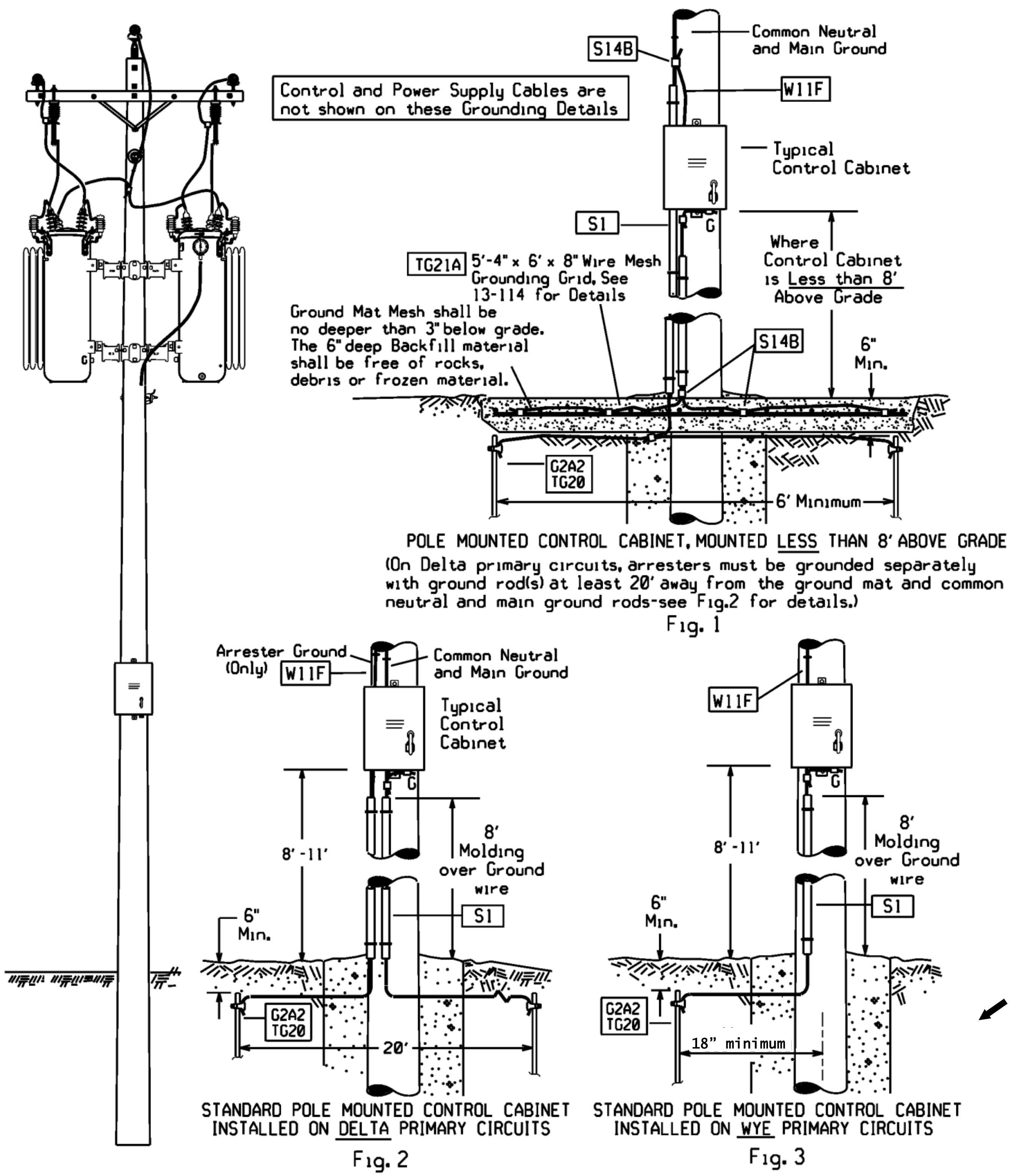
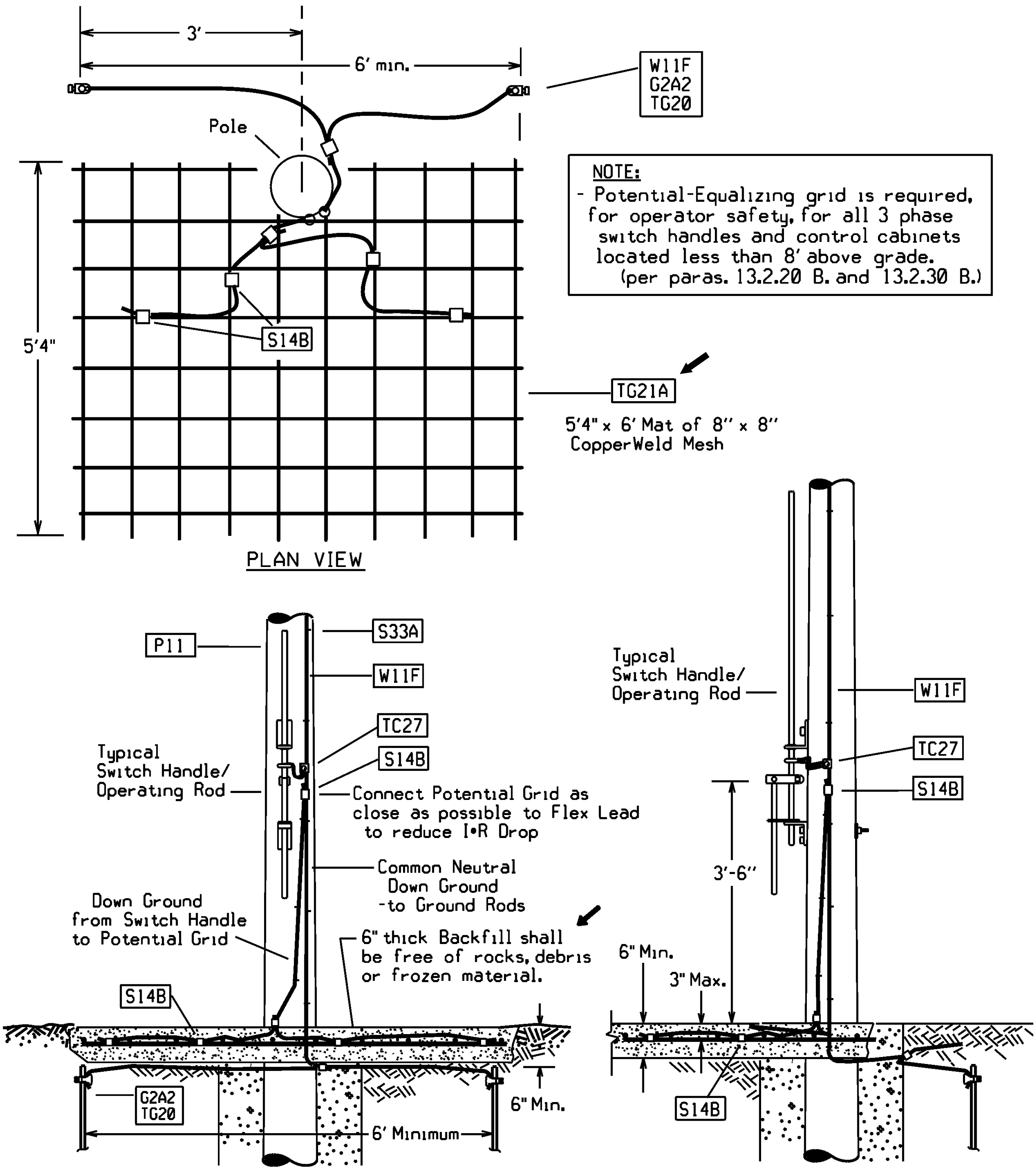


Fig. 1

Fig. 2

Fig. 3

Supersedes 7/12 – Changed the text describing Figure 1. Revised ground rod location to read 18" minimum from center of pole.

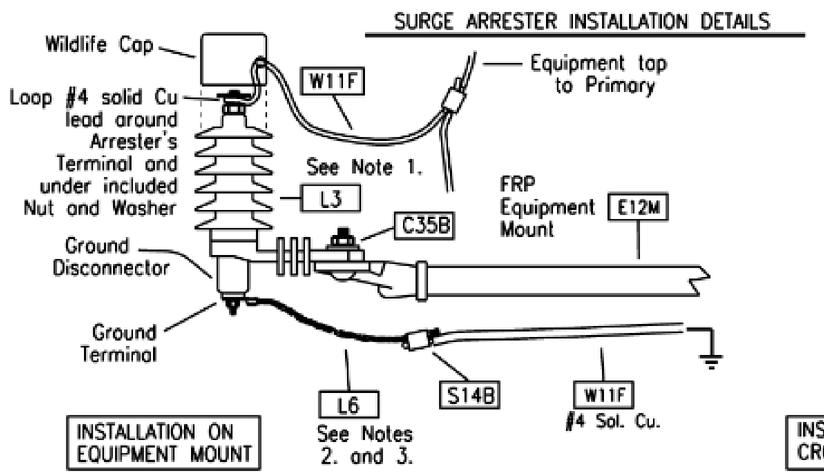


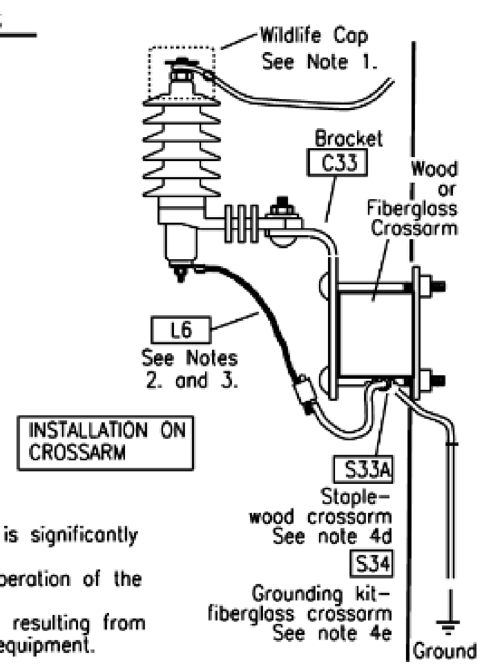
Supersedes 7/12 - Issue – Revised title text to match index.

GROUNDING GRID FOR MANUALLY OPERATED SWITCH HANDLE

ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	
7/20	13-114		

Supersedes 7/20 Issue – Added information for arrester grounding leads on fiberglass crossarms.



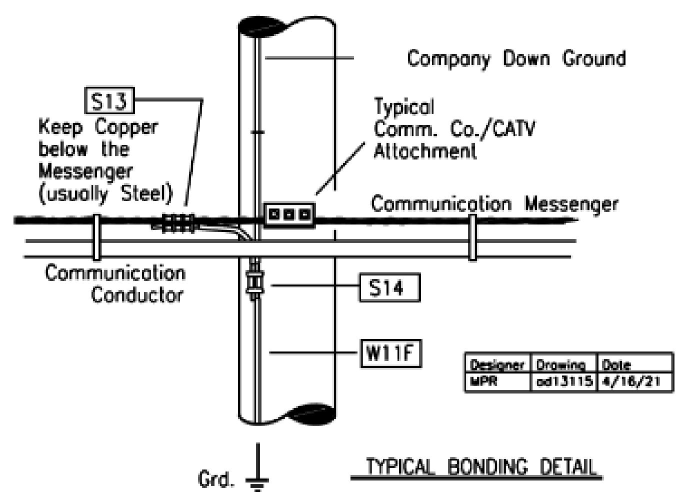


SURGE ARRESTER INSTALLATION NOTES:

1. Keep arrester lead(s) length to a minimum. Arrester performance is significantly reduced by long conductors. See Text Section 13.0.30.
2. Flexible braid grounding lead (Item L6) must be used to permit operation of the disconnector. Do not staple, restrain or shorten flex lead.
3. Grounding arrangement shall be installed so that a detached lead, resulting from a faulted arrester, can not make contact with live conductors or equipment.
4. Installing arresters on wood or fiberglass crossarms:
   a. All three phases are protected by arresters:
      Arrester ground leads should be attached to the bottom of the crossarm to restrain blown disconnectors. A ground wire should be attached under the crossarm between arrester ground leads to connect all of the arresters to the down ground.
   b. Two phases are protected by arresters:
      Arrester ground leads should be attached to the bottom of the crossarm to restrain blown disconnectors. Maintain 20" of wood insulation between the arrester ground leads attached to the crossarm and metal hardware supporting insulators of the phase not protected by an arrester. This may require floating all or part of the lead to the down ground.
   c. One phase is protected by an arrester:
      The arrester ground lead should be attached to the bottom of the crossarm to restrain a blown disconnector. Maintain 20" of wood insulation between the arrester ground lead attached to the crossarm and metal hardware supporting insulators of either of the other two phases. This may require floating all or part of the lead to the down ground.
   d. Attach arrester ground leads to wood crossarms using staples (S33A).
   e. Attach arrester ground leads to fiberglass crossarms using grounding kit (S34).
5. CAUTION: The Top and bottom connections of arresters are limited to 20 ft-lbs torque. DO NOT OVERTIGHTEN.

GENERAL BONDING NOTES:

1. The NESC currently requires the bonding of communications messengers and effectively grounded system neutrals.
2. Communication mesenger strand shall not be bonded to vertical ground conductor unless that conductor is connected to the electric neutral or messenger.
3. Bond spacer cable messenger to common neutral at each support pole and to a driven ground at frequent points, not more than 800' apart.
4. Bond the messenger of primary lashed aerial cable to secondary or common neutral at each transformer, at ends of each secondary and elsewhere to provide a bond at every fourth pole.
5. Bolted connectors should not be used to splice or bond ground wires.



Designer	Drawing	Date
MPR	od13115	4/16/21

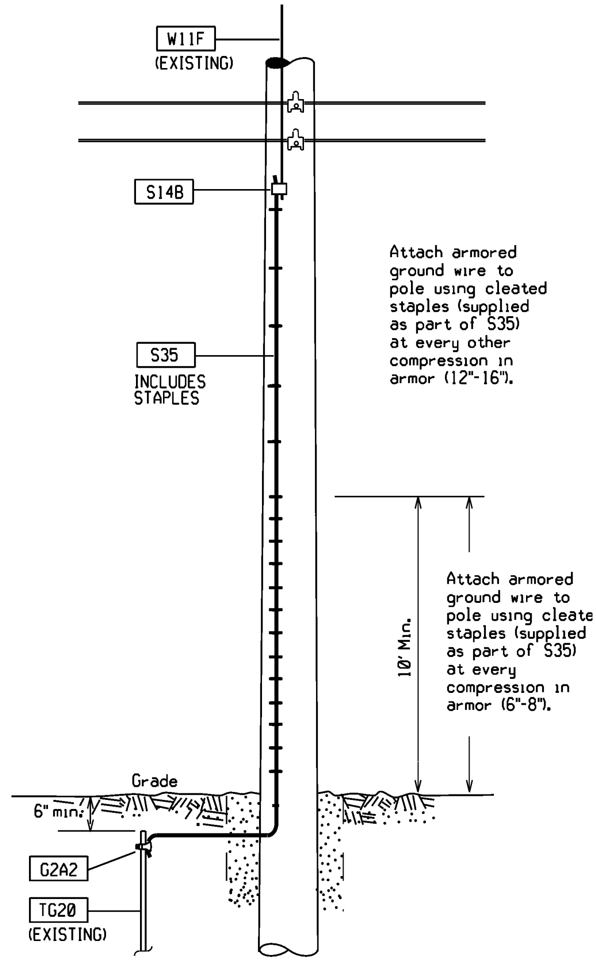
TYPICAL ARRESTER GROUNDING & DOWN-GROUND BONDING

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	13-115	7/21

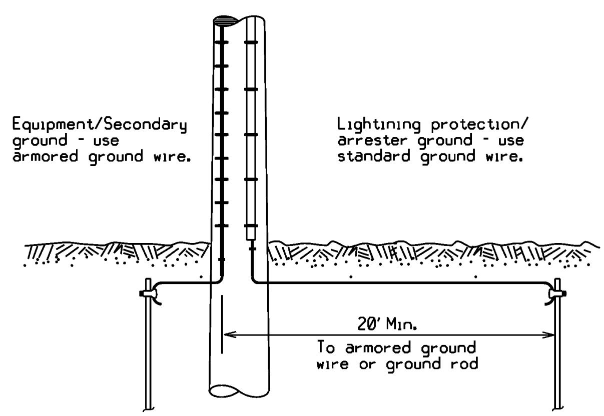
APPLICATION NOTES:
1. The armored down ground kit (S35) shall be used to replace stolen ground wires on distribution poles. The kit may be used for new ground wires in areas where ground wire theft has been a problem.
2. The armored down ground kit (S35) may not be used on poles where connections to the down ground wire below communication wire level are required. Examples would be poles with steel riser sweeps or pipes and poles with switch handles or control cabinets.

DELTA AND OTHER NON-EFFECTIVELY GROUNDED SYSTEMS:
1. In delta and other non-effectively grounded systems, with two ground wires on a pole, at least one must use a standard insulated ground wire – only one of the ground wires at these poles may use the armored ground wire.
2. Use the standard insulated ground wire for the lightning arrester ground.
3. The isolated grounds must be separated by at least 20' of soil. The ground rod connected to the insulated ground wire must be at least 20' from the other ground rod or any portion of the armored ground wire in the soil. Install new ground rod(s) as required to maintain the required separation.
4. As an alternative, the lightning arrester and secondary neutral grounds may be placed on different poles using the armored ground wire kit at each pole. The arrester ground must be on the pole with the arrester(s) and the secondary neutral may be grounded at an adjacent pole.

INSTALLATION NOTES:
1. Ground wire molding is not required over armored ground wire.
2. The armored down ground kit (S35) includes an 18' piece of the armored ground wire with pre-stripped ends and cleated staples.
3. At ground rod, use a new standard ground rod clamp (G2A2).
4. At top of armored ground wire (below communications), use a new compression connector (S14B) to connect new ground wire to existing ground wire on pole.
5. It is not necessary to replace existing connections to existing ground wire for communication messengers. Install new connections to existing ground wires for communication messengers where existing ground wire passes communication messenger and no connection is present – use #4 copper SD covered wire (W11F) and new compression connectors (S14B).



TYPICAL POLE WITH SINGLE DOWN GROUND



DOUBLE DOWN GROUND ARRANGEMENT
DELTA CIRCUIT

New Page – July 2014.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
10	7/21	• Added information for arrester grounding leads on fiberglass crossarms.		
9	7/20	• Drawing 13-115: Added detail showing upper arrester connection. • Revised title text of drawings 13-111 & 13-114 to match index.		
8	7/17	• Drawing 13-115: Added Note 5 on torque limits on arresters to Surge Arrester Installation notes. Revised Note 5 on use of bolted connectors in bonding to General Bonding Notes.		
7	7/15	• Section 13.1.10A – Clarified grounding requirement. • Section 13.1.10G – Updated references to 13.2.20B and 13.2.30B. • Section 13.6.40 – added requirement for arresters on load side of cutout mounted reclosrs. • 13-111 – Revised distance for ground rod to pole. • 13-113 – Revised note on Fig. 1 & revised distance for ground rod to pole.		
6	7/14	• Added new page 13-116 with armored ground wire for use for stolen ground wire replacement.		
5	7/12	• Revised ground mat size on pages 13-113 and 13-114.		
4	7/11	• Added Note 4 to top drawing on page 13-115, clarifying requirements for restraining arrester ground leads.		
3	7/10	• Revised 13.2.20 and 13.2.30 to clarify testing requirements for grounds in delta systems. • Replaced 13.6.30 with new sections 13.6.30 through 13.6.50 to clarify arrester application requirements.		

Version	Date	Modification	Author(s)	Approval by (Name/Title)
2	7/09	• Under 13.0.20, clarified communication messenger bonding requirement. • Under 13.3.40, communication messenger bonding information modified. • Required additional staples for theft prevention on bottom 8 feet of downground on page 13-111. • Modified arrester and tank grounds for grounded-wye transformers on page 13-112.		
1	07/08	• Under 13.3.40, communication messenger bonding information modified. • Under 13.6.30.A.3, clarified application of surge arresters on existing fused taps. • Under 13.6.30.B.5, location of arresters at capacitors corrected. • Added ground lead from arrester to transformer tank on page 13-112. • Corrected page title on page 3-114. • Modified communication bonding requirements on page 3-115.		

Supersedes 7/13 Issue – Added new codes on page 14-50 and 14-54 Physical data Code

Revised title of 14-377; Added new drawing 14-379.

14.0 GENERAL

This section covers the details of installing and connecting transformers. It also provides guidance on selection of dual voltage rated versus single voltage rated transformers. While conventional transformers are the standard transformer, completely self protected (CSP) transformers will be covered for maintenance purposes. The selection of transformer size and loading is covered in Section 10-Secondaries. Details of fusing, grounding, and lightning protection are covered in Section 12-Fuses and Section 13-Grounding.

In general, conventional ANSI Standard Distribution Transformers will be purchased and considered as the "Standard" transformers for the overhead system. However, existing transformers in good condition shall be used or reused whenever practical.

Normal transformer design life is derived from projected material heat aging of its internal components. The nameplate kVA rating of the transformer is the load at which the unit can be continuously operated in severe (high temperature) conditions without loss of service life. Generally, transformers may, for limited periods, be loaded above nameplate. See Page 10-10.

14.1 LOCATION

The location of transformers is discussed in Section 10-Secondaries. In general, transformers shall be placed as near to the center of the load served as possible.

Transformers shall be installed only on sound poles with a life expectancy of at least 10 years. Placement on corners, junctions, or other congested poles should be avoided. Banks should be located to minimize exposure to traffic when practicable.

When transformers are placed on poles carrying joint construction or street lighting fixtures, special care must be taken to provide required clearances. Where extra pole height can be avoided by turning the transformer to permit the secondary to pass by the case at higher level, such method should be used as shown on Page 14-121.

14.2 SIZING AND LOADING

Transformer size and loading is discussed in Section 10-Secondaries.

14.3 INSTALLATION

Details for installing overhead transformers in 3 phase applications are shown starting at Page 14-301. The recommended maximum sizes shown on these drawings are based on modern transformers mounted on standard poles. When the poles are already heavily stressed by wire loading, heavy down guys, or by unbalanced angle or service pulls, pole strength should be checked. Transformers heavier than recommended maximum may be used with approval of Standards Engineering. (See Page 14-80 for approximate weights of transformers).

Clearances and crossarm pole top designs for the various standard size and types of transformers and voltages are shown on Pages 14-200 thru 14-300. Consult Section 14-Transformer Index for specific applications. **Note: See Section 16-Aerial/Spacer Cable for additional designs of transformer installations on spacer cable.**

Supersedes 1/06 Issue - Corrected Ppge reference in 3rd paragraph on Section 14.0

14.4 CONNECTIONS

14.4.10 Secondary Connections

Secondary connections for overhead transformers are shown in Section 10. Transformers shall not normally be banked (multiple banks on the same secondary net) on the secondary side. Polyethylene or other covered copper conductors are recommended transformer leads with sizes as shown in Table 1 and 2. Equivalent aluminum conductors with compression type aluminum to copper transition terminals may be substituted.

Use the following copper conductors for secondary in air.

Table 1

FOR 3 PHASE BANKS		
Transformer kVA Size (Each Tank)	**L.V. Copper Conductor Size**	
	208Y/120 V Secondary	**480Y/277 V Secondary**
10 & 15	#2 (W13E)	#2 (W13E)
25	#4/0 (W19C)	#2 (W13E)
37½ & 50	#4/0 (W19C)	#4/0 (W19C)
75	500 kcmil (UC9G)	#4/0 (W19C)
100	Double 4/0	#4/0 (W19C)
167	Double 500 kcmil	500 kcmil (UC5G)

Table 2

FOR 1 PHASE TRANSFORMERS	
Transformer kVA Size	**L.V. Copper Conductor Size 120/240 V**
5 – 25	#2 (W13E)
37½ – 75	#4/0 (W19C)

Note: Double #4/0 may be substituted for single 500 kcmil above.

14.4.20 Primary Connections

Primary connections and grounding details are shown on the installation drawings starting on Page 14-204. No connection diagrams are shown for unigrounded neutral circuits. When transformers are installed, such circuits shall be converted to the multigrounded systems as discussed in Section 13-Grounding.

Connection diagrams are not shown for Open Wye or Open Delta banks or for Scott connections. Also, omitted are connections for 4,160 V Delta, 6,900 V, 11,000 V, and other special circuits. If such installations are essential, details shall be furnished by Engineering Design.

The use of distribution transformers as voltage boosters is not recommended.

Use the copper conductors shown on Table 3 for connections of the transformer high-voltage bushing to the primary circuit. Due to breakage concerns, #2 Cu AWG is the minimum recommended conductor size.

Table 3

<table>
<tr><th colspan="6">PRIMARY WIRING FOR OVERHEAD TRANSFORMERS</th></tr>
<tr><th>Description</th><th colspan="2">Size & Bushing</th><th>Conductor</th><th>Std. Item</th><th>Item ID</th></tr>
<tr><td>Standard Secondary Transformers</td><td>10 – 167 kVA</td><td>H.V.</td><td>#2 Str. Cu.</td><td rowspan="3">W13E</td><td rowspan="3">4001042</td></tr>
<tr><td rowspan="3">Primary Dual Voltage/Step-Down Transformers</td><td>50 – 167 kVA</td><td>H.V. & L.V.</td><td>#2 Str. Cu.</td></tr>
<tr><td rowspan="2">250 – 500 kVA</td><td>H.V.</td><td>#2 Str. Cu.</td></tr>
<tr><td>L.V.</td><td>#4/0 Str. Cu.</td><td>W33C</td><td>4020111</td></tr>
</table>

Supersedes 7/08 Issue – Revised Table 1 Standard Item #

Supersedes 7/10 Issue – Revised 14.5.

14.5 SELECTION OF TRANSFORMERS

Conventional transformers are to be used for all new installations. When existing CSP transformers are replaced, conventional transformers with external fusing shall be used. Where space is limited, consider a pole top extension or replace the existing pole with a taller pole. If a single CSP transformer in a 3 phase bank needs to be replaced because it has failed, external fusing shall be used for all three transformers in the bank. Anytime a CSP transformer is taken out of service for routine maintenance or emergency repairs, it shall have an open style fused cutout (s) installed. The CSP transformers shall be fused as a conventional transformer. **WARNING: Never** use CSP transformers for 3 phase banks on Delta secondary systems (an open CSP secondary breaker would result in undesirable voltage imbalances and reduces load capability).

Normally, a new 3 phase service will not be made available for a residential service. Non-residential loads greater than 100 kVA shall be supplied by 3 a phase service. New 3 phase services requiring larger than 3-100 kVA, 208Y/120 (3-167 kVA if 480Y/277) transformers shall be supplied by non-pole mounted equipment.

Single bushing transformers shall not be used for Wye-Delta connections. See Page 14-78 for recommended transformers for most common distribution circuits. Refer to Section 22-Material Catalog for a listing of standard transformers.

14.5.10 Protection

For cutout fuse selection for conventional transformers, and current limiting fuse selection for conventional and CSP transformers, see Section 12-Protection.

14.6 GROUNDING OF TRANSFORMERS

See Section 13-Grounding for details on grounding transformers

14.7 STEP-DOWN/STEP-UP TRANSFORMERS

Certain branch lines may be supplied through step-down/step-up transformers for the following reasons:

A. Where immediate conversion is not economically justified.
B. To relieve load from a lower voltage distribution feeder.

Conversely, certain branch feeders requiring immediate conversion to a higher voltage, where conversion of the entire area is not justified, may be supplied through step-up transformers.

14.7.10 Step-down/step-up Transformer Connections

Table 1 shows what transformers to use for step-down/ step-up transformers. Engineering Design will issue the phasor connection diagram(s) when the branch line that is supplied from a step-down/step-up transformers, may be phased to either another feeder or branch of the same feeder of equal voltage rating.

Table 1

Primary Feeder – 3 Phase	Secondary Feeder – 3 Phase: For 3 Phase, 3 Wire Feeders of 2400 or 4800 Volts Delta		Secondary Feeder – 3 Phase: 3 Phase, 4 Wire of 4160, 8320, 12470, 13200 or 13800 Volts Wye	
	Transformer Primary Voltage Rating	Transformer Connection	Transformer Primary Voltage Rating	Transformer Connection
12470 Volts Wye 4 Wire	7200/12470Y	Wye-Delta	7200/12470Y	Wye-Wye
13200 Volts 3 Wire	13800/23900Y (At 95% Taps)	Delta-Delta	13800/23900Y (At 95% Taps)	Delta-Wye
13200 Volts Wye 4 Wire	7620/13200Y(1) 13800/23900Y(2) (At 95% Taps)	Wye-Delta Delta-Delta	7620/13200Y(1) 13800/23900Y(2) (At 95% Taps)	Wye-Wye Delta-Wye
13800 Volts 3 Wire	13800/23900Y (At 100% Taps)	Delta-Delta	13800/23900Y (At 100% Taps)	Delta-Wye
13800 Volts Wye 4 Wire	7970/13800Y 13800/23900Y(2) (At 100% Taps)	Wye-Delta Delta-Delta	7970/13800Y 13800/23900Y(2) (At 100% Taps)	Wye-Wye Delta-Wye
23000 Volts 3 Wire	22900	Delta-Delta	22900	Delta-Wye
23000 Volts Wye 4 Wire	13800/23900Y (At 100% Taps)	Wye-Delta	13800/23900Y (At 100% Taps)	Wye-Wye
34500Volts Wye 4 Wire	-	-	19920/34500Y	Wye-Wye

14.7.20 Neutral Connection

Wye-Delta connections shall have the high side neutral not connected.

Wye-Wye connection shall have both the high and low side neutrals connected together and to the system and connected to a driven ground.

Delta-Wye connection shall have the low side neutral connected to the low side feeder neutral and to a driven ground.

14.7.30 Floating Wye/Delta Step-down/Step-up Transformer Installation/Operation Recommendations

A. Installation

1. Consistency in installations and conformance with the construction standards needs to be followed.

2. Proper secondary load balancing can improve the voltage supply quality during normal and abnormal events significantly reducing overvoltages from occurring. The maximum allowable current unbalance should not be greater than 25%, which has been determined through experience and independent research. The current unbalance is determined by measuring the current of each of the three legs and then calculating the percent current unbalance using the following formula

Supersedes 1/06 Issue – Revised wording in paragraph 14.7.30.

$$\text{Percent Current Unbalance} = \frac{\text{Maximum current difference in any leg from average current}}{\text{Average current}} \times 100$$

3. Single-phase line-to-neutral load shall not be installed between the high side single-phase fuse cutout/disconnect and the step-down/step-up bank.

4. For new construction, a solid blade cutout shall be installed between the floating high side neutral bushings and the common neutral and/or ground. The cutout blade should be removed and secured to the pole. This cutout will be used to temporarily ground the floating Wye neutral for routine switching of the high side fuses/disconnects or main line single phase switching that feeds the step-down/step-up transformer(s). This cutout shall be closed prior to any routine switching being performed to energize or de-energize the transformers. **The cutout shall be open for normal operations with the blade removed and secured to the pole.**

5. For existing installations where a solid blade grounding cutout has not been installed between the floating high side neutral bushings and the common neutral and/or ground, a solid blade cutout shall be installed between the floating high side neutral bushings and the common neutral and/or ground. This cutout will be used to temporarily ground the floating Wye neutral for routine single phase switching of the high side fuses/disconnects or main line single phase switching that feeds the step-down/step-up transformers. This cutout shall be closed prior to any routine single phase switching being performed to energize or de-energize the transformers. **The cutout shall be open for normal operations with the blade removed and secured to the pole.**

6. High side arresters shall be installed on the source side of fused cutouts/disconnects. Low side arresters can remain on the transformers.

7. Fault locators can be installed on the low side of the step-down/step-up transformer to help identify failures quickly.

8. Fuse only the high side of step-down transformers.

9. There may be specific instances where a high side 3 phase circuit interrupter may be required. Each feeder will need to be evaluated to determine if such a device is necessary due to inadequate protection from fuses on the high side of the bank.

10. A low side gang operated loadbreak switch may be required if the bank is a dedicated supply to an aerial cable or underground cable. This will eliminate the possibility for ferroresonent conditions developing.

11. Group operated loadbreak switch devices should be used on the delta side of a floating wye-delta step-down bank.

Supersedes 7/15 Issue – Add item 11 under 14.7.30A.

14.7.40 Protection

The step-down/step-up transformers shall be protected by one of the following methods:

A. Conventional fusing
B. Conventional fusing with current limiting fuses
C. Recloser

The choice would depend on the relative importance, load, short circuit current available, and exposure of the branch.

Surge arresters shall be installed on the primary and secondary sides and connected to a driven ground on same pole.

Surge arresters on the Wye side of a floating Wye-Delta installation shall be connected on the source side of the fuses. When a high side fuse blows, there is a neutral shift that causes the voltage on load side of the fuse device to rise above the maximum withstand voltage of the lightning arrester. The arrester will experience thermal runaway, overheat, and then fail.

14.8 PHASING TRANSFORMERS

In Rhode Island, there are several phase rotations utilized throughout the system. Each installation is unique and must be addressed with Engineering Design.

14.8.10 Step-down/Step-up Transformers

When step-down/step-up transformers are installed, they establish new voltages and phase rotations (Systems). It is desirable to identify phases on these systems and to understand the phase rotation and position so they may be paralleled with others of the same voltage.

If two such systems are to be paralleled, the voltage, rotation, and phase position must be the same.

Do not load larger (over 100 kVA) step-down/step-up transformers over 100% of nameplate rating. Overloading will significantly reduce the service life of the transformers.

Feeder protection at primary step-down/ratio bank installations, as shown on standard installation drawings in this Section, shall be provided by fused disconnects (cutouts) on the source side of the bank. Solid blade disconnecting devices may additionally be used on the load side of the bank so bank isolation can be accomplished.

14.8.20 Three Phase Distribution Banks

The drawings for normal distribution transformer banks are arranged for the most convenient wiring of the secondary. They should be followed exactly wherever this is practical. If two overhead transformer banks are to be paralleled, the wiring on each should be identical. If a standard transformer bank is to be paralleled with a 3 phase transformer (padmount or power/station unit type), it may have to be rewired so that phasing is correct.

Supersedes 7/10 Issue – Page break changes because of changes on page

14.9 SPECIAL CONNECTIONS

14.9.10 Open-Wye and Open-Delta Connected Banks for 3 Phase Services Only

A. Limit application to the use of 25 kVA transformers or smaller on 2400 Delta, 4160 Wye, 4800 Delta and 8320 Wye volt feeders. 50 kVA transformers or smaller may be used on 12,470 Wye; 13,200 Delta or Wye; 13,800 Delta or Wye; 23,000 Delta or Wye; and 34,500 Wye volt feeders.

B. Open-Wye and Open-Delta connected transformer banks can be used for the emergency operation of either Delta-Delta or Wye-Delta connected banks when one of the units becomes inoperative. These banks can also be used to supply 3 phase, 4 wire delta loads composed of a large single phase load in conjunction with a small 3 phase load.

C. When these connections are used to operate purely Delta connected loads under emergency conditions or when one unit out of a Wye-Delta or Delta-Delta bank becomes inoperative, loading of the bank is reduced. If the bank in question is to be connected Open-Wye, the Wye must be grounded. The reduced loading on these banks is equal to 57.7% of the original three unit bank or 86% of the combined kVA of the two units connected.

D. This transformer connection can be used to supply 3 phase, 4 wire Delta connected loads, composed of large single phase loads in conjunction with small 3 phase Delta loads. This application usually involves the use of different sized (kVA) transformers, with the larger single phase load taken off of the larger of the two transformers.

The selection of correct transformer size (kVA) is dependent on both the connected 3 phase and single phase load. The calculation of the load expected on each transformer is as follows:

kVA_L = load on larger transformer (both 3 phase and single phase)
kVA_T = load on small transformer (small 3 phase delta)
T = kVA load 3 phase
S = kVA load single phase

Where

$$kVA_L = (S^2 + T^2/3 + ST)^{1/2}$$

$$kVA_T = \frac{\sqrt{3}}{3} T$$

The aforementioned equations assume unity power factor for both single and 3 phase loads.

For example, assume in the course of converting a 5 kV feeder to 15 kV, a customer is encountered with both a 60 A, 240 V Delta service and a 200 A, 120/240 V single phase service. Presently, the customer is being supplied from both a 15 kVA 3 phase Delta pole type transformer and a 25 kVA single phase pole type transformer. Furthermore, the customer is not willing to upgrade his service to 208Y/120 V. Average demand on the customer's 3 phase service is found to be less than 15 kVA and that of the single phase load is found to be 30 kVA. With this information, an Open-Wye bank can be sized to fit the customer's service requirements.

T = kVA load 3 phase = 15 kVA

S = kVA load single phase = 30 kVA

$kVA_L = (30^2 + 15^2/3 + (30)(15))^{1/2}$

$kVA_L = (1425)^{1/2} = 38kVA$

$kVA_T = \frac{\sqrt{3}}{3}(30) = 17kVA$

In this case, the customer's present three-phase and single-phase service requirements could be handled by an Open-Wye connected bank composed of both a 50 kVA and 15 kVA transformer. The single phase load must be taken from the 50 kVA transformer.

14.10 HANDLING RETURNED TRANSFORMERS

14.10.10 Procedures

The following guideline outlines procedures for handling returned distribution transformers, including overhead, pad-mounted, subsurface, and subway types.

14.10.20 When To Junk Transformers

Transformers shall be junked under the following conditions:

A. Transformers 7.5 kVA and below.
B. Non-usable ratings – declare surplus before junking.
C. Cast iron cases.
D. Nonstandard mounting.
E. Repair parts not available.
F. Primary Codes 035 and 095.
G. Tap Codes 77, 78, 83 and 89.
H. PCB transformers (500 ppm and above). **WARNING:** Transformers containing PCB fluid require special handling.
I. Transformers manufactured during or before 1970 unless the unit is required for assurance/back-up.
J. Pole type single phase transformers manufactured by Cooper Power Systems at Nacogdoches, Texas during or before January, 2012.

Supersedes 7/08 Issue – Modifications to Process 14.10.20.

14.10.30 When To Return Transformers To Stock For Reissue

Return transformers to stock for reissue, without electrical testing, if all of the following apply:

A. Transformer has non-PCB label.
B. Transformer was removed on routine change-out or due to new construction.
C. Transformer bushings, terminals, protective coatings, and other accessory equipment are in good condition.
D. Single phase transformer with secondary voltage rating of 120/240 or 240/480 (E/2E) with internal secondary connections set up for three wire operation. This applies to transformers with three low voltage terminals 100 kVA and below.

In addition:

A. Assign new physical data code to transformer if not already assigned.
B. Inspect condition of transformer markings and replace if necessary.
C. Remove bottom portion of “Transformer On Stock Status” tag.
D. Transfer transformer to stock.

Supersedes 7/08 Issue - Added Type Code 42; fixed footer.

DESCRIPTION – Code numbers specify five basic items regarding transformers as follows:

00	000	00	00	00
Type Code (Table 1)	Primary Code (Table 2)	Secondary Code (Table 3)	Tap Code (Table 4)	Fuse & Switch Code (Table 5)

TABLE 1 – TYPE CODE

KEY	
OA – Mineral Oil-Filled, Air Cooled	**LF – Less Flammable-Filled, Air Cooled**
10	Overhead – OA
11	Overhead – OA w/Stainless Steel Tank
13	Overhead – LF
17	Overhead – CSP – OA – with Built In Overload Tripout
18	Pole type Pad Mounted Deadfront
20	Auto-Transformer – OA
30	Pad-mounted – Loop Feed – Dead Front – OA
31	Pad-mounted – Loop Feed – Dead Front – OA w/Stainless Steel Tank
32	Pad-mounted – Loop Feed – Live Front – OA
34	Pad-mounted – Loop Feed – Dead Front – LF
40	Subway – OA
41	Subway – OA – Low Profile
42	Subway – LF – Walk-In Vault
50	Pad-mounted – Radial Feed – Dead Front – OA
52	Pad-mounted – Radial Feed – Live Front – OA
54	Pad-mounted – Radial Feed – Dead Front – LF
56	Pad-mounted – Radial Feed – Dead Front – Dry
60	Network – OA
62	Network – LF
65	Network – Pad-mounted – LF
70	Subsurface – Radial Feed – OA
72	Subsurface – Loop Feed – OA
80	Self-Regulated – OA
90	Station Type
99	Other – Not Listed
Note:	Transformer types listed above may or may not have surge arresters.

TABLE 2 - PRIMARY CODE

KEY:

(-) Voltage Nomenclature
E_1 = √3 E
E_2 = Any Value of E Other Than E, E_1, or 2E

* - One Primary Bushing - Single Phase Overhead Transformers
** - Two Primary Bushings - Single Phase Overhead
*** - Junk Codes

SINGLE PHASE TRANSFORMERS (001 – 500)

001 – 025	E **
005	480
007	600
010	11500
011	12000
012	13800
013	22000
014	13200
015	22900
017	34400
018	34500
022	11000
023	14400

026 – 050	E/2E **
035	2300/4600 ***
040	11000/22000
042	11550/23100

076 – 088	E X 2E **
080	1200 X 2400
082	2400 X 4800
085	11000 X 22000
086	11500 X 23000

089 – 100	E X E_2 **
095	22000 X 33000 ***

101 – 150	E/E_1 Y **
108	2160/3740Y
109	2400/4160Y
112	4160/7200Y
114	4800/8320Y
116	6930/12000Y
118	7200/12470Y
119	7620/13200Y
120	7970/13800Y
125	11500/19900Y
126	12000/20780Y
127	12470/21600Y
129	13200/22860Y
131	13800/23900Y
133	14400/24940Y
140	19920/34500Y

151 - 200	E_1 Grounded Y/E *
155	3740 Grounded Y/2160
157	4160 Grounded Y/2400
159	8320 Grounded Y/4800
165	12470 Grounded Y/7200
167	13200 Grounded Y/7620
169	13800 Grounded Y/7970
175	22860 Grounded Y/13200
177	24940 Grounded Y/14400
178	34400 Grounded Y/19860
180	34500 Grounded Y/19920

Supersedes 7/13 Issue – Corrected footer.

TABLE 2 – PRIMARY CODE (Continued)

SINGLE PHASE TRANSFORMERS (001 – 500) (Continued)

201 – 250	**E/E Grounded Y ****
217	13200/22860 Grounded Y
220	14400/24940 Grounded Y

251 – 300	**E/E_1Y x E/E_1Y ****
255	2160/3740Y x 7620/13200Y
257	2400/4160Y x 4800/8320Y
258	2400/4160Y x 7200/12470Y
259	2400/4160Y x 7620/13200Y
260	2400/4160Y x 7970/13800Y
263	2400/4160Y x 13800/23900Y
264	4160/7200Y x 7620/13200Y
265	4160/7200Y x 7970/13800Y
267	4160/7200Y x 12470/21600Y
269	4160/7200Y x 13800/23900Y
271	4160/7200Y x 14400/24900Y
272	4800/8320Y x 7200/12470Y
273	4800/8320Y x 7620/13200Y
275	4800/8320Y x 7970/13800Y
277	4800/8320Y x 14400/24940Y
280	7200/12470Y x 19920/34500Y
281	7620/13200Y x 19920/34500Y
282	7970/13800Y x 19920/34500Y

301 – 350	**E1 Grd Y/E x E1 Grd Y/E ***
310	3740 GrdY/2160 x 13200 GrdY/7620
315	4160 GrdY/2400 x 12470 GrdY/7200
316	4160 GrdY/2400 x 13200 GrdY/7620
317	4160 GrdY/2400 x 13800 GrdY/7970
325	8320 GrdY/4800 x 12470 GrdY/7200
326	8320 GrdY/4800 x 13200 GrdY/7620
327	8320 GrdY/4800 x 13800 GrdY/7970
330	12470 GrdY/7200 x 34500 GrdY/19920
331	13200 GrdY/7620 x 34500 GrdY/19920
332	13800 GrdY/7970 x 34500 GrdY/19920
333	13800 GrdY/7970 x 23900 GrdY/13800

401 – 425	**(E/E_1 Y x E/E_1 Y x E/E_1 Y ****
405	2400/4160Y x 7200/12470Y x 7620/13200Y
408	2400/4160Y x 7620/13200Y x 7970/13800Y
415	2400/4160Y x 7200/12470Y x 14400/24940Y
419	4800/8320Y x 7620/13200Y x 7970/13800Y
420	2400/4160Y x 7200/12470Y x 7970/13800Y

426 – 450	**E_1 Grd. Y/E x E_1 Grd. Y/E x E_1 Grd. Y/E ***
432	4160 GrdY/2400 x 13200 GrdY/7620 x 13800 GrdY/7970

451 – 460	**E_1 Grd. Y/E x E_1 Grd. Y/E x E_1 Grd. Y/E x E_1 Grd. Y/E ****
453	2400/4160Y x 7200/12470Y x 7620/13200Y x 7970/13800Y

461 - 475	**E_1 Grd Y/E x E_1 Grd Y/E x E_1 Grd Y/E x E_1 Grd Y/E ***

500	**Other**

Supersedes 7/08 Issue – Corrected footer.

TABLE 2 – PRIMARY CODE (Continued)

THREE PHASE TRANSFORMERS (501 – 999) (Continued)

501 – 550	**E**	**501 – 550**	**E**
505	480	532	12470
507	600	533	13200
515	2400	534	13500
520	4160	535	13800
523	4800	537	14400
525	8320	540	22900
529	11000	542	23900
530	11500	545	34500

551 – 575	**E_1Y**

576 – 600	**E x 2E**
580	2400 x 4800
592	11500 x 23000

601 – 635	**E x E_2**
605	2400 x 4160
610	2400 x 13200
612	2400 x 13800
614	3740 x 13200
616	4160 x 12470
617	4160 x 13200
619	4160 x 13800
621	4800 x 8320
622	4800 x 13200
623	4800 x 13800
624	8320 x 12470
630	13800 x 22860

636 – 650	**E/E_1 Y**
640	2400/4160Y

651 – 675	**E_1 Y/E**
652	4160Y/2400

676 – 725	**E_1 Grd Y/E**
682	4160 GrdY/2400
684	4330 GrdY/2500
690	12470 GrdY/7200
691	13200 GrdY/7620
693	13800 GrdY/7970
695	22900 GrdY/13220
700	24900 GrdY/14400
705	34500 GrdY/19920

726 – 740	**E/E_1 Y/E**
730	2400/4160Y/2400

750 - 755	**E_2 x E_1 Grd Y/E**
750	4800 x 13200 GrdY/7620

826 – 875	**E_1 Grd Y/E x E_1 Grd Y/E**
828	3740 GrdY/2160 x 13200 GrdY/7620
832	4160 GrdY/2400 x 12470 GrdY/7200
833	4160 GrdY/2400 x 13200 GrdY/7620
835	4160 GrdY/2400 x 13800 GrdY/7970
840	8320 GrdY/4800 x 12470 GrdY/7200
841	8320 GrdY/4800 x 13200GrdY/7620
843	8320 GrdY/4800 x 13800 GrdY/7970
860	12470 GrdY/7200 x 34500 GrdY/19920
861	13200 GrdY/7620 x 34500 GrdY/19920
862	13800 GrdY/7970 x 34500 GrdY/19920

876 – 900	**E/E_1 Grd Y/E**

901 – 925	**E/E_1 Y x E x E_1 Y/E**
905	2400/4160Y x 2400 x 13800Y/7970

926 – 950	**E x E_2 x E_2**
935	4160 x 4800 x 13200

951 – 970	**T**
951	4160T
955	12470T
957	13200T
959	13800T

971 – 990	**T x T**
971	4160T x 12470T
973	4160T x 13200T
975	4160T x 13800T
980	4800T x 13200T

990 – 999	**Others**
997	23000 x 34500
999	Other

Supersedes 7/13 Issue – Added Code 695.

TABLE 3 – SECONDARY CODE

KEY:

(-) Voltage Nomenclature
E_1 = $\sqrt{3}$ E
E_2 = Any Value of E Other Than E, E_1, or 2E

SINGLE PHASE TRANSFORMERS (01 – 50)

01 – 09	E
01	120
02	240
05	480
07	600
08	14400

21 – 24	E x 2E
21	120 x 240
22	240 x 480
23	292 x 584
24	300 x 600

31 – 40	E/E_1 Y
31	120/208Y
32	265/460Y
33	277/480Y
34	4160/7200Y
35	2400/4160Y
36	4800/8320Y
37	7200/12470Y
38	7620/13200Y
39	7970/13800Y
40	12000/20780

44 – 46	E/E_1 Y x E/E_1 Y
44	2400/4160Y x 4800/8320Y
45	2400/4160Y x 7200/12470Y
46	2400/4160Y x 7620/13200Y

10 – 15	E/2E
10	120/240
11	115/230
12	240/480
14	292/584

25 – 30	E x E_2
26	277 x 600
27	300 x 650
28	480 x 600
30	600 x 2400

41 – 43	E_1 Grd Y/E
41	13200 GrdY/7620
42	4160 GrdY/2400

47 – 50	Others
47	120/240/208
48	2400/4160Y x 4160/7200Y
49	120/240/480/600
50	Other

16 – 20	2E/E
16	240/120
17	480/240

Supersedes 7/20 Issue – Addition of new code 57 and 87.

THREE PHASE TRANSFORMERS (51 – 99)

51 – 57	E
51	240
52	480
53	600
54	2400
55	4800
56	11500
57	13800

69 – 71	E/E_1 Y
70	7200/12470Y
71	4360Y/2520

79 – 82	E_1 Grd Y/E
79	4160 GrdY/2400
80	12470 GrdY/7200
81	13200 GrdY/7620
82	13800 GrdY/7970

90 – 94	T
90	240T
91	208T/120
92	480T/277
93	480T x 240T
94	600T

72 – 78	E_1 Y/E
72	216Y/125
73	208Y/120
74	480Y/277
75	4160Y/2400
76	13200Y/7620
77	13800Y/7970
78	600Y/346

83 – 85	E/E_1 Y/E
83	2400/4160Y/2400

95 – 99	OTHERS
95	120 x 240/208Y
96	480Y/277 x 208Y/120
97	600 x 2400 x 4800
98	480Y/277 x 600Y/346
99	600 x 2400

61 – 65	E x 2E
61	240 x 480
63	2400 x 4800

86 - 87	E_1 Grd Y/E
86	11500 GrdY/6640
87	22900 GrdY/13220

TABLE 4 – TAP CODE

KEY:

A = Taps Above Primary Nameplate Rating
B = Taps Below Primary Nameplate Rating

* Codes 14, 21 and 22 replaced actual codes in GIS prior to 5/20/2011 and are only used to reference GIS records preceding that date. All codes are now valid for use in GIS.

** Junk Codes (see Section 14.10)

00	**None**
01	1 - 2½ A
02	2 - 2½ A
04	4 - 2½ A
11	1 - 2½ B
12	2 - 2½ B
13	3 - 2½ B
14	4 - 2½ B
15	5 - 2½ B
21	1 - 2½ A + 3 - 2½ B
22	2 - 2½ A + 2 - 2½ B
23	3 - 2½ A + 1 - 2½ B
27	2 - 2½ A + 4 - 2½ B
29	4 - 2½ A + 2 - 2½ B
31	1 - 5 A
32	2 - 5 A
34	4 - 5 A
41	1 - 5 B
42	2 - 5 B
43	3 - 5 B
44	4 - 5 B
51	1 - 5 A + 2 - 2½ B
53	1 - 5 A + 1 - 5 B
61	1 - 10 A
65	1 - 10 B
72	4160 Volt

75	2520/2460/<u>2400</u>/2340/2280 Volt (Code 22*)
76	4360/4260/<u>4160</u>/4055/3590 Volt (Code 22*)
77	5040/4920/4680/4560 Volt **
78	8720/8520/8100/7900 Volt **
79	11275/<u>11000</u>/10725/10450/10175 Volt (Code 21*)
80	11800/<u>11500</u>/11200/10900/10600 Volt (Code 21*)
82	13090/12780/<u>12470</u>/12160/11850 Volt (Code 22*)
83	13200/12480/11500 Volt **
84	14400/<u>13800</u>/13200/12870/12540 Volt (Code 21*)
85	13860/13530/<u>13200</u>/12870/12540 Volt (Code 22*)
86	<u>14400</u>/14100/13800/13500/13200 Volt (Code 14*)
87	14400/14100/<u>13800</u>/13500/13200 Volt (Code 22*)
88	15600/15000/<u>14400</u>/13800/13200 Volt (Code 22*)
89	17200/16770/15910/15480 Volt **
90	14100/<u>13800</u>/13500/13200/12900 Volt (Code 21*)
92	23473/<u>22900</u>/22328/21755/21183 Volt (Code 21*)
94	36200/35300/<u>34400</u>/33500/32600 Volt (Code 22*)
96	36225/35363/<u>34500</u>/33638/32775 Volt (Code 22*)
98	<u>14400</u>/14040/13680/13320/12960 Volt (Code 14*)
99	Others

Supersedes 7/12 Issue – Updated Tap Code 92; corrected footer.

Supersedes 1/06 Issue – Corrected footer.

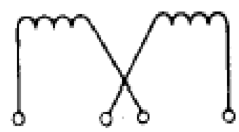
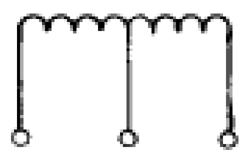
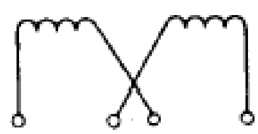
TABLE 5 – FUSE & SWITCH CODE (00 – 99)

00	None
01	Bayonet Fuse Holder (Loadbreak) With Expulsion Link Without Isolation Link Or Current Limiting Fuse
02	Bayonet Fuse Holder (Loadbreak) With Expulsion Link And With Isolation Link
04	Bayonet Fuse Holder (Loadbreak) With Current Limiting Fuse
05	Bayonet Fuse Holder (Loadbreak) With Expulsion Link And With Current Limiting Fuse Under Oil
07	Bayonet Fuse Holder (Loadbreak) With Expulsion Link Without Isolation Link Or Current Limiting Fuse And With Four Position Loadbreak Switch Under Oil
08	Bayonet Fuse Holder (Loadbreak) With Expulsion Link With Isolation Link And With Four Position Loadbreak Switch Under Oil
11	Drywell Cannister (Loadbreak) With Current Limiting Fuse
12	Drywell Cannister (Non-Loadbreak) With Current Limiting Fuse
21	Externally Mounted Hinge Type, Current Limiting Fuse
32	Current Limiting Fuse With Arc-Strangler Loadbreaking Device
33	Single Current Limiting Fuse (Clip Mounted) And Arc-Strangler Switchblade (Tandem-Unit Mounting)
34	Parallel Current Limiting Fuses (Clip Mounted) And Arc-Strangler Switchblade (Tandem-Unit Mounting)
35	Single Current Limiting Fuse (Hinge Mounted)
36	Parallel Current Limiting Fuse (Unitized-Hinge Mounted)
37	Single Current Limiting Fuse (Clip Mounted)
38	Parallel Current Limiting Fuse (Unitized-Clip Mounted)
51	Internal Weak Link Fuse Under Oil
53	Internal Weak Link Fuse Under Oil With Secondary Breaker
55	Secondary Breaker With No Internal Weak Link Fuse Under Oil
60	Two Position Loadbreak Switch Under Oil Without Fuse
61	Four Position Loadbreak Switch Under Oil Without Fuse
62	Four Position Loadbreak Switch Under Oil With Current Limiting Fuse
75	Three Position Deadbreak Switch With Two Electrical Interlocks Scheme
76	Three Position Mag Break Switch With Locked Energized Interlock Scheme
80	Network Protector
99	Other

EXPLANATION OF VOLTAGE RATINGS

KEY:

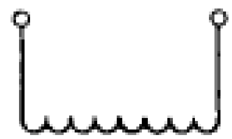
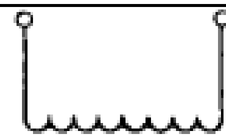
$E_1 = \sqrt{3}\ E$
E_2 = Any Value Of E Other Than E, E_1 or 2E

SINGLE PHASE TRANSFORMERS					
Primary Code Numbers	**Secondary Code Numbers**	**Symbol (Voltage)**	**Typical Rating**	**Typical Winding**	**Explanation**
001-025	01 - 09	E	34500		Indicates a winding for connection on an E volt system.
026-050	10 - 15	E/2E	120/240		Indicates a winding for multiple, series or three-wire service.
051-075	16 - 20	2E/E	240/120		Indicates a winding for 2E volts, two-wire full kVA, or for 2E/E volts three-wire service with one-half kVA available from mid-point to each outside terminal.
076-088	21 - 24	E x 2E	1200 x 2400		Indicates a winding for multiple or series operation only. (Not for three-wire service).
089-100	25 - 30	E x E_2	22000 x 33000		
101-150	31 - 40	E/E_1 Y	2400/4160 Y		Indicates a winding for connection on an E volt system or Y connection on an E_1 volt system.

Supersedes 1/06 Issue – Corrected footer.

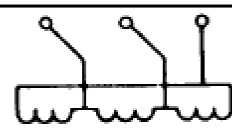
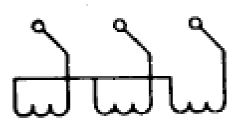
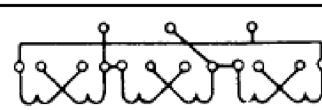
EXPLANATION OF VOLTAGE RATINGS (Continued)

SINGLE PHASE TRANSFORMERS (Continued)

Primary Code Numbers	Secondary Code Numbers	Symbol (Voltage)	Typical Rating	Typical Winding	Explanation
151-200	41 - 43	E_1 GrdY/E	124700 GrdY/7200		Indicates a winding with reduced insulation at the neutral end. The neutral end may be connected directly to the tank for connection single phase or in Y on an E_1 volt system with the neutral end of the winding effectively grounded.
201-250	--	E/E_1Grd Y	7620/13200 Grd Y		Indicates a winding with reduced insulation for Y connection on an E_1 volt system with the transformer neutral effectively grounded or for connection on an E volt system.
251-300	44 - 45	E/E_1 Y x E/E_1 Y	2400/4160 Y x 7200/12470 Y		Indicates a winding for connection on an E volt system of Y connection on an E_1 volt system.
301-350	--	E_1 Grd Y/E x E_1 Grd Y/E	4160 Grd Y/2400 x 12470 Grd Y/7200		Indicates a winding with reduced insulation of the neutral end. The neutral end may be connected directly to the tank for connection single phase or in Y on an E_1 volt system with the neutral end of the winding effectively grounded.
401-425	--	E/E_1 Y x E/E_1 Y x E/E_1 Y	2400/4160 Y x 7200/12470 Y x 7620/13200 Y		Indicates a winding for connection on an E volt system or Y connection on an E_1 volt connection.

Supersedes 1/06 Issue – Corrected footer.

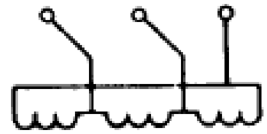
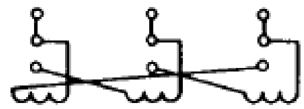
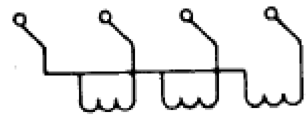
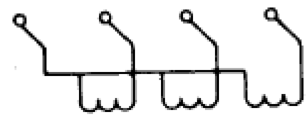
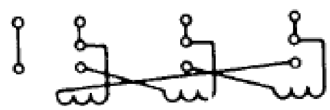
EXPLANATION OF VOLTAGE RATINGS (Continued)

SINGLE PHASE TRANSFORMERS (Continued)					
Primary Code Numbers	**Secondary Code Numbers**	**Symbol (Voltage)**	**Typical Rating**	**Typical Winding**	**Explanation**
426-450	--	E_1 Grd Y/E x E_1 Grd Y/E x E_1 Grd Y/E	4160 Grd Y/2400 x 12470 Grd Y/7200 x 13800 Grd Y/7970		Indicates a winding with reduced insulation at the neutral end. The neutral end may be connected directly to the tank for connection single phase or in Y on and E_1 volt system with the neutral end of the winding effectively grounded.
451-460	--	E/E_1 Y x E/E_1 Y x E/E_1 Y x E/E_1 Y	2400/4160 Y x 7200/12470 Y x 7620/13200 Y x 7970/13800 Y		Indicates a winding for connection on an E volt system or Y connection on an E_1 volt system.
461-475	--	E_1 Grd Y/E x E_1 Grd Y/E x E_1 Grd Y/E x E_1 Grd Y/E	3740 Grd Y/2160 x 4160 Grd Y/2400 x 13200 Grd Y/7620 x 13800 Grd Y/7970		Indicates a winding with reduced insulation at the neutral end. The neutral end may be connected directly to the tnak for connection single phase or in Y on an E_1 volt system with the neutral end of the winding effectively grounded.
THREE PHASE TRANSFORMERS					
501-550	51 - 57	E	11500		Indicates a winding permanently connected.
551-575	58 - 60	E_1 Y	4160 Y		Indicates a winding permanently Y connected with the neutral isolated.
576-600	61 - 65	E x 2E	2400 x 4800		Indicates a permanently connected winding for multiple or series operation.

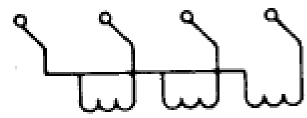
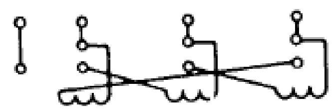
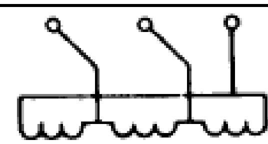
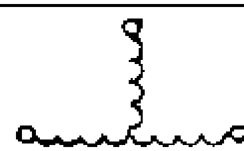
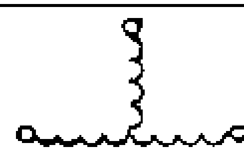
Supersedes 1/07 Issue – Corrected footer.

EXPLANATION OF VOLTAGE RATINGS (Continued)

Supersedes 1/07 Issue – Corrected footer.

THREE PHASE TRANSFORMERS (Continued)					
Primary Code Numbers	**Secondary Code Numbers**	**Symbol (Voltage)**	**Typical Rating**	**Typical Winding**	**Explanation**
601-635	66 - 68	E x E_2	2400 x 13200		Indicates a winding permanently connected.
636-650	69 - 71	E/E_1 Y	2400/4160 Y		Indicates a winding for connection E volts or E_1Y volts with the neutral isolated.
651-675	72 - 77	E_1 Y/E	4160 Y/2400		Indicates a winding permanently Y connected with fully insulated neutral available.
676-725	78 - 82	E_1 Grd Y/E	13800 Grd Y/7970		Indicates a winding having reduced insulation and permanently Y connected with the transformer neutral grounded.
726-740	83 - 85	E/E_1 Y/E	2400/4160 Y/2400		Indicates a winding for connection E volts or E_1Y volts with a fully insulated neutral available.
750	73 - 74	E_2 x E_1 Grd Y/E	4800 x 13200 GrdY/7620		Indicates a winding for connection E_2 volts or E_1Y volts having a reduced insulation and permanently connected with the transformer neutral grounded.

EXPLANATION OF VOLTAGE RATINGS (Continued)

THREE PHASE TRANSFORMERS (Continued)					
Primary Code Numbers	**Secondary Code Numbers**	**Symbol (Voltage)**	**Typical Rating**	**Typical Winding**	**Explanation**
826-875	--	E_1 Grd Y/E x E_1 Grd Y/E	4160 Grd Y/2400 x 13800 Grd Y/7970		Indicates a winding having reduced insulation and permanently Y connected with the transformer neutral grounded.
876-900	--	E/E_1 Grd Y/E	7970/13800 Grd Y/7970		Indicates a winding having reduced insulation for Y connection on an E_1 volt system with the transformer neutral grounded, or for connection on an E volt system.
901-925	--	E/E_1 Y/E x E_1 Y/E	2400/4160 Y/2400 x 13800 Y/7970		
926-950	--	E x E_2 x E_2	4160 x 4800 x 13200		Indicates a winding permanently connected.
951-970	90 - 94	T	13800 T		Indicates a primary winding consisting of two windings - the main and a teaser.
971-990	--	T x T	4160 T x 13800 T		Indicates a primary winding consisting of two windings - the main and a teaser.
991-999	95 - 99	Others -	Those Three Phase Transformers That Do Not Fall Into One Of The Classifications Above		

Supersedes 1/06 Issue – Corrected footer.

1. **NOTE VOLTAGE** marked on transformer nameplate and transformer tag. All changes to internal connections should be made in the shop.

2. **POLARITY DESIGNATION** - Additive has X1 on the right and H1 on the left as viewed from the secondary side. Subtractive has X1 and H1 on the left as viewed from the secondary side. Single phase transformers, 200 kVA and under having high voltage winding rated 8660 volts and below, have additive polarity. All other single phase transformers have subtractive polarity.

3. **SECONDARY CONNECTIONS**

   A. 120/240 (E/2E) and 240/480 (E/2E) can be connected for series, parallel or three wire operation. Transformers 100 kVA and below have three low voltage terminals and transformers 167 - 500 kVA have four low voltage terminals. See Figures 1 through 14.
   B. 240/120 (2E/E) can be connected for three wire or two wire operation, but not for parallel operation. Note - only one-half of the kVA rating available between center tap terminal and either extreme terminal. Three low voltage terminals are provided on all kVA sizes. See Figures 15 through 18.
   C. 292 x 584 (E x 2E) can be connected for series or parallel operation. Transformers will have four low voltage terminals on all kVA sizes. See figures 8, 9, 11 and 12. This rating must be used with primary taps.
   D. 277/480 Y (E/E_1Y) and 600 (E) transformers have two low voltage terminals on all sizes. See Figures 19 through 21.

New single ratio overhead transformers for existing 600 V customers should be ordered 292 x 584 with primary taps so that 600 V can be obtained from the 584 volt connection. These transformers can also be used at 277 volts. Specify the 600 V rating for dual ratio transformers.

4. **100 kVA AND BELOW WITH E/2E VOLT SECONDARIES – PRIMARY 8660 VOLTS AND BELOW**

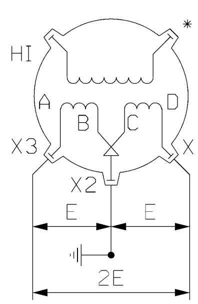


FIG. 1
(Three Wire)
Additive

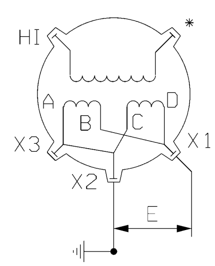


FIG. 2
(Parallel)
Additive

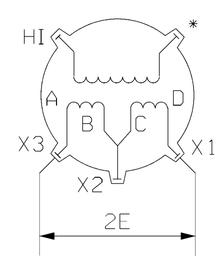


FIG. 3
(Series)
Additive

* Transformers with one primary bushing have other end of coil connected to the tank.

Supersedes 1/06 Issue – Corrected footer.

5. 100 kVA AND BELOW WITH E/2E VOLT SECONDARIES – PRIMARY ABOVE 8660 VOLTS

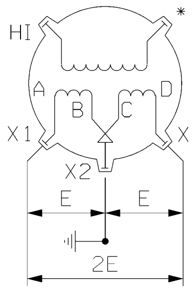


FIG. 4
(Three Wire)
Subtractive

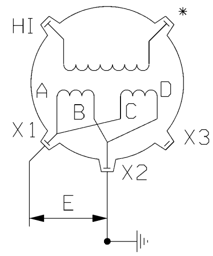


FIG. 5
(Parallel)
Subtractive

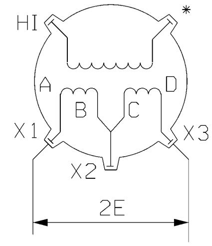


FIG. 6
(Series)
Subtractive

6. 167 kVA WITH E/2E AND 167 kVA AND BELOW WITH E X 2E VOLT SECONDARIES – PRIMARY 8660 VOLTS AND BELOW

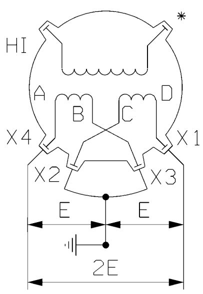


FIG. 7
(Three Wire)
Additive

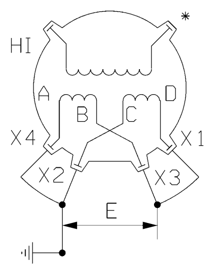


FIG. 8
(Parallel)
Additive

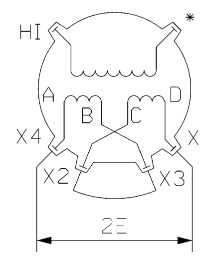


FIG. 9
(Series)
Additive

* Transformers with one primary bushing have other end of coil connected to the tank.

7. 167 kVA WITH E/2E AND 167 kVA AND BELOW WITH E X 2E VOLT SECONDARIES – PRIMARY ABOVE 8660 VOLTS

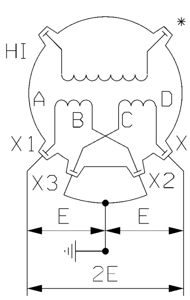


FIG. 10
(Three Wire)
Subtractive

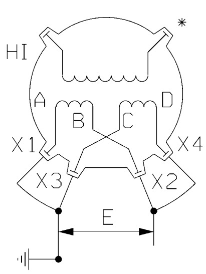


FIG. 11
(Parallel)
Subtractive

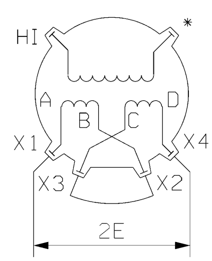


FIG. 12
(Series)
Subtractive

Supersedes 1/06 Issue – Corrected footer.

8. 250 – 500 kVA WITH E/2E AND E X 2E VOLT SECONDARIES – PRIMARY ABOVE AND BELOW 8660 VOLTS

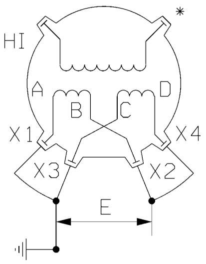


FIG. 13
(Parallel)
Subtractive

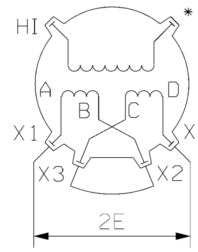


FIG. 14
(Series)
Subtractive

* Transformers with one primary bushing have other end of coil connected to the tank.

9. 167 kVA AND BELOW WITH 2E/E VOLT SECONDARIES

PRIMARY 8660 VOLTS AND BELOW

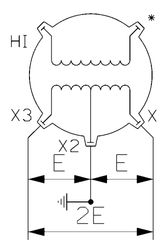


FIG. 15
(Three Wire)
Additive

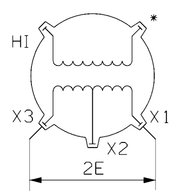


FIG. 16
(Two Wire)
Additive

PRIMARY ABOVE 8660 VOLTS

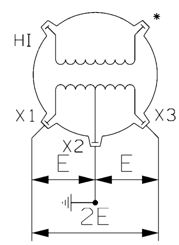


FIG. 17
(Three Wire)
Subtractive

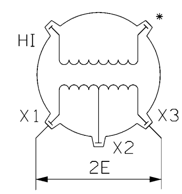


FIG. 18
(Two Wire)
Subtractive

10. 25 – 500 kVA WITH E OR E_1/Y VOLT SECONDARIES

25 – 167 kVA PRIMARY 8660 VOLTS AND BELOW

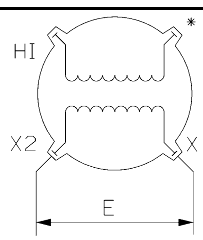


FIG. 19
Additive

250 – 500 kVA PRIMARY 8660 VOLTS AND BELOW

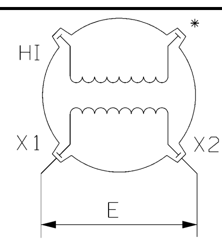


FIG. 20
Subtractive

25 – 500 kVA PRIMARY ABOVE 8660 VOLTS

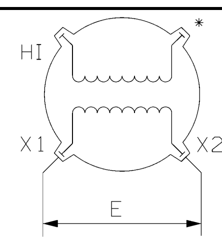


FIG. 21
Subtractive

Supersedes 1/06 Issue – Corrected footer.

CIRCUIT VOLTAGE			PRI. CODE	SEC. CODE	TAP CODE	STD. ITEM	TRANSFORMER NAMEPLATE VOLTAGES		STD. KVA SIZES	3Ø DIAGRAM #
PRIMARY	SECONDARY	PHASE					PRIMARY	SECONDARY		
2400 V DELTA 3 WIRE	120/240	1Ø ΔY	258 259 260	10 10 10	00 00 00	T91AD T91AF T91AC	2400/4160Y x 7200/12470Y 2400/4160Y x 7620/13200Y 2400/4160Y x 7960/13800Y	120/240	10-100	-
	208Y/120	3Ø ΔY	258 259 260	10 10 10	00 00 00	T91AD T91AF T91AC	2400/4160Y x 7200/12470Y 2400/4160Y x 7620/13200Y 2400/4160Y x 7960/13800Y	120/240	10-100	2
	480Y/277	3Ø ΔY	258 259 260	33 33 33	00 00 00	T91AE	2400/4160Y x 7200/12470Y 2400/4160Y x 7620/13200Y 2400/4160Y x 7960/13800Y	277/480Y	25-167	2
	240 (1) (2)	3Ø ΔΔ	258 259 260	10 10 10	00 00 00	T91AD T91AF T91AC	2400/4160Y x 7200/12470Y 2400/4160Y x 7620/13200Y 2400/4160Y x 7960/13800Y	120/240	10-100	8
	480 (1) (2)	3Ø ΔY (5)	258 259 260	33 33 33	00 00 00		2400/4160Y x 7200/12470Y 2400/4160Y x 7620/13200Y 2400/4160Y x 7960/13800Y	277/480Y	25-167	2 or 4
	600 (1) (2)	3Ø ΔΔ	258 259 260	23 23 23	00 00 00		2400/4160Y x 7200/12470Y 2400/4160Y x 7620/13200Y 2400/4160Y x 7960/13800Y	292 X 584	25-167	8
4160 V WYE 4 WIRE	120/240	1Ø YY	258 259 260	10 10 10	00 00 00	T91AD T91AF T91AC	2400/4160Y x 7200/12470Y 2400/4160Y x 7620/13200Y 2400/4160Y x 7960/13800Y	120/240	10-100	-
	208Y/120	3Ø YY	258 259 260	10 10 10	00 00 00	T91AD T91AF T91AC	2400/4160Y x 7200/12470Y 2400/4160Y x 7620/13200Y 2400/4160Y x 7960/13800Y	120/240	10-100	1
	480Y/277	3Ø YY	258 259 260	33 33 33	00 00 00		2400/4160Y x 7200/12470Y 2400/4160Y x 7620/13200Y 2400/4160Y x 7960/13800Y	277/480Y	25-167	1 or 3
	240 (1) (3)	3Ø YΔ (4)	258 259 260	10 10 10	00 00 00	T91AD T91AF T91AC	2400/4160Y x 7200/12470Y 2400/4160Y x 7620/13200Y 2400/4160Y x 7960/13800Y	120/240	10-100	7
	480 (1) (3)	3Ø YY (5)	258 259 260	33 33 33	00 00 00		2400/4160Y x 7200/12470Y 2400/4160Y x 7620/13200Y 2400/4160Y x 7960/13800Y	277/480Y	25-167	1 or 3
	600 (1) (3)	3Ø YΔ (4)	258 259 260	23 23 23	00 00 00		2400/4160Y x 7200/12470Y 2400/4160Y x 7620/13200Y 2400/4160Y x 7960/13800Y	292 X 584	10-100	7
4800 V DELTA 3 WIRE	120/240	1Ø ΔY	272 273 275	10 10 10	00 00 00	 T91BA T91BC	4800/8320Y x 7200/12470Y 4800/8320Y x 7620/13200Y 4800/8320Y x 7960/13800Y	120/240	10-100	
	208Y/120	3Ø ΔY	273 275	10 10	00 00		4800/8320Y x 7620/13200Y 4800/8320Y x 7960/13800Y	120/240	10-100	2
	480Y/277	3Ø ΔY	273 275	33 33	00 00		4800/8320Y x 7620/13200Y 4800/8320Y x 7960/13800Y	277/480Y	25-167	2 or 4
	240 (1) (2)	3Ø ΔΔ	273 275	10 10	00 00		4800/8320Y x 7620/13200Y 4800/8320Y x 7960/13800Y	120/240	10-100	8
	480 (1) (2)	3Ø ΔY (5)	273 275	33 33	00 00		4800/8320Y x 7620/13200Y 4800/8320Y x 7960/13800Y	277/480Y	10-100	2
	600 (1) (2)	3Ø ΔΔ	273 275	23 23	00 00		4800/8320Y x 7620/13200Y 4800/8320Y x 7960/13800Y	292 X 584	25-167	8
8320 V WYE 4 WIRE	120/240	1Ø YY	272 273 275	10 10 10	00 00 00	 T91BA T91BC	4800/8320Y x 7200/12470Y 4800/8320Y x 7620/13200Y 4800/8320Y x 7960/13800Y	120/240	10-100	-
	208Y/120	3Ø YY	272 273 275	10 10 10	00 00 00	 T91BA T91BC	4800/8320Y x 7200/12470Y 4800/8320Y x 7620/13200Y 4800/8320Y x 7960/13800Y	120/240	10-100	1
	480Y/277	3Ø YY	273 275	33 33	00 00		4800/8320Y x 7620/13200Y 4800/8320Y x 7960/13800Y	277/480Y	25-167	1 or 3
	240 (1) (3)	3Ø YΔ (4)	272 273 275	10 10 10	00 00 00	 T91BA T91BC	4800/8320Y x 7200/12470Y 4800/8320Y x 7620/13200Y 4800/8320Y x 7960/13800Y	120/240	10-100	7
	480 (1) (3)	3Ø YY (5)	273 275	33 33	00 00		4800/8320Y x 7620/13200Y 4800/8320Y x 7960/13800Y	277/480Y	25-167	1 or 3
	600 (1) (3)	3Ø YΔ (4)	273 275	23 23	00 00		4800/8320Y x 7620/13200Y 4800/8320Y x 7960/13800Y	292 X 584	10-100	7

Supersedes 1/07 Issue - Updated Primary Codes.

Supersedes 1/06 Issue – Corrected footer.

CIRCUIT VOLTAGE			PRI. CODE	SEC. CODE	TAP CODE	STD. ITEM	TRANSFORMER NAMEPLATE VOLTAGES		STD. KVA SIZES	3Ø DIAGRAM #
PRIMARY	SECONDARY	PHASE					PRIMARY	SECONDARY		
12470 V WYE 4 WIRE	120/240	1Ø YY	165	10	00	T91DA	12470GRDY/7200	120/240	10-100	-
	208Y/120	3Ø YY	165	10	00	T91DA	12470GRDY/7200	120/240	10-100	1
	480Y/277	3Ø YY	165	33	00	T91DC	12470GRDY/7200	277/480Y	25-167	1 or 3
	240 (1) (2)	3Ø YΔ (4)	118	10	00	T91DA	7200/12470Y	120/240	10-100	7
	480 (1) (2)	3Ø YY (5)	165	33	00	T91DC	12470GRDY/7200	277/480Y	25-167	1 or 3
	600 (1) (2)	3Ø YΔ (4)	118	23	00		7200/12470Y	292 X 584	25-167	7
13200 V WYE 4 WIRE	120/240	1Ø YY	167	10	00	T91DE	13200GRDY/7620	120/240	10-100	-
	208Y/120	3Ø YY	167	10	00	T91DE	13200GRDY/7620	120/240	10-100	1
	480Y/277	3Ø YY	167	33	00	T91DEA	13200GRDY/7620	277/480Y	25-167	1 or 3
	240 (1) (3)	3Ø YΔ (4)	119	10	00	T91DE	7620/13200Y	120/240	10-100	7
	480 (1) (3)	3Ø YY (5)	167	33	00	T91DEA	13200GRDY/7620	277/480Y	25-167	1 or 3
	600 (1) (3)	3Ø YΔ (4)	119	23	00		7620/13200Y	292 X 584	10-100	7
13200 V DELTA 3 WIRE	120/240	1Ø ΔY	133	10			14400/24940Y (at 13200 V tap)	120/240	10-100	
	208Y/120	3Ø ΔY	133	10			14400/24940Y (at 13200 V tap)	120/240	10-100	2
	480Y/277	3Ø ΔY	133	33			14400/24940Y (at 13200 V tap)	277/480Y	25-167	2 or 4
	240 (1) (2)	3Ø ΔΔ	133	10			14400/24940Y (at 13200 V tap)	120/240	10-100	8
	480 (1) (2)	3Ø ΔY (5)	133	33			14400/24940Y (at 13200 V tap)	277/480Y	10-100	2
	600 (1) (2)	3Ø ΔΔ	133	23			14400/24940Y (at 13200 V tap)	292 X 584	25-167	8
13800 V WYE 4 WIRE	120/240	1Ø YY	169	10	00	T91EB	13800GRDY/7960	120/240	10-100	-
	208Y/120	3Ø YY	169	10	00	T91EB	13800GRDY/7960	120/240	10-100	1
	480Y/277	3Ø YY	169	33	00	T91EBA	13800GRDY/7960	277/480Y	25-167	1 or 3
	240 (1) (3)	3Ø YΔ (4)	120	10	00	T91EA	7960/13800Y	120/240	10-100	7
	480 (1) (3)	3Ø YY (5)	169	33	00	T91EBA	13800GRDY/7960	277/480Y	25-167	1 or 3
	600 (1) (3)	3Ø YΔ (4)	120	23	00		7960/13800Y	292 X 584	10-100	7
13800 V DELTA 3 WIRE	120/240	1Ø ΔY	133	10			14400/24940Y (at 13800 V tap)	120/240	10-100	-
	208Y/120	3Ø ΔY	133	10			14400/24940Y (at 13800 V tap)	120/240	10-100	2
	480Y/277	3Ø ΔY	133	33			14400/24940Y (at 13800 V tap)	277/480Y	25-167	2 or 4
	240 (1) (2)	3Ø ΔΔ	133	10			14400/24940Y (at 13800 V tap)	120/240	10-100	8
	480 (1) (2)	3Ø ΔY (5)	133	33			14400/24940Y (at 13800 V tap)	277/480Y	25-167	2
	600 (1) (2)	3Ø ΔΔ	133	23			14400/24940Y (at 13800 V tap)	292 X 584	10-100	8
23000 V WYE 4 WIRE	120/240	1Ø YY	177	10			24900GRDY/14400 (at 13800 V tap)	120/240	10-100	-
	208Y/120	3Ø YY	177	10			24900GRDY/14400 (at 13800 V tap)	120/240	10-100	1
	480Y/277	3Ø YY	177	33			24900GRDY/14400 (at 13800 V tap)	277/480Y	25-167	1 or 3
	240 (1) (3)	3Ø YΔ (4)	144	10			14400/24940Y (at 13800 tap)	120/240	10-100	7
	480 (1) (3)	3Ø YY (5)	144	33			14400/24940Y (at 13800 tap)	277/480Y	25-167	1 or 3
	600 (1) (3)	3Ø YΔ (4)	144	23			14400/24940Y (at 13800 tap)	292 X 584	10-100	7
23000 V DELTA 3 WIRE	120/240	1Ø ΔY	015	10	00		22900	120/240	10-100	-
	208Y/120	3Ø ΔY	015	10	00		22900	120/240	10-100	2
	480Y/277	3Ø ΔY	015	33	00		22900	277/480Y	25-167	2 or 4
	240 (1) (2)	3Ø ΔΔ	015	10	00		22900	120/240	10-100	8
	480 (1) (2)	3Ø ΔY (5)	015	33	00		22900	277/480Y	25-167	2
	600 (1) (2)	3Ø ΔΔ	015	23	00		22900	292 X 584	10-100	8

CIRCUIT VOLTAGE			PRI. CODE	SEC. CODE	TAP CODE	STD. ITEM	TRANSFORMER NAMEPLATE VOLTAGES		STD. KVA SIZES	STD. DRAWING	3Ø DIAGRAM #
PRIMARY	SECONDARY	PHASE					PRIMARY	SECONDARY			
34500 V WYE 4 WIRE	120/240	1Ø YY	180	10	00	T91HC	34500GRDY/19920	120/240	10-100		-
	208Y/120	3Ø YY	180	10	00	T91HC	34500GRDY/19920	120/240	10-100		1
	480Y/277	3Ø YY	180	33	00	T91HD	34500GRDY/19920	277/480Y	25-167		1
	240 (1) (3)	3Ø YΔ (4)	180	10	00	T91HC	19920/34500Y	120/240	10-100		7
	480 (1) (3)	3Ø YY (5)	180	33	00	T91HD	19920/34500Y	277/480Y	25-167		7
	600 (1) (3)	3Ø YΔ (4)	180	23	00		19920/34500Y	292 X 584	10-100		7

Supersedes 1/06 Issue – Deleted " Recommended Transformer" note at top of table. Correct primary code for 2400V Delta 3 wire

Notes:

1. Non-standard voltage – for maintenance only.
2. For Open-Delta connection, see Diagram #10.
3. For Open-Wye connection, see Diagram #9.
4. Do not ground the primary neutral.
5. Company will only supply a 480Y service. Customer must provide protection from ground faults on a 480 V Delta service.

<u>INSTALLATION NOTES:</u>

- Use conventional mineral filled transformers for new installations. Physical Data Code for Type is 10.
- For less flammable filled conventional transformers for special installations, Physical Data Code for Type is 13.
- Use CSP transformers for maintenance only in New York. Physical Data Code for Type is 17.
- Use transformers without taps unless otherwise directed. Physical Data Code for Taps is 00.
- Unless otherwise directed, internal fused or switches are not needed. Physical Data Code for Fuses and Switches is 00
- For other transformer voltages and configurations, refer to the Physical Data Code on Page 14-101.
- **Do not use CSP transformers on Delta Secondary Systems.** A tripped breaker will result in customer voltage imbalance.
- 167 kVA, 120/120V transformers have 4 low voltage bushings. 277 V transformers have 2 low voltage bushings. All others have 3 low voltage bushings.
- 277 V secondary transformers with primary ± taps can supply existing 265 V customers. Primary taps must be +5% (max. setting) to provide 263 volts secondary.
- Non-directly connected CSP surge arresters (pre-1990 units only) shall be gapped as follows: 2,400 V – ¼"; 4,800 V – ⅜"; 7,620 V – ½".
- Single bushing transformers shall not be used for Wye-Delta connections.
- For 3Ø Delta connected transformers (ΔΔ, YΔ), use transformers with identical turns ratios (preferable from same manufacturer) on all three phases to guard against capacity loss. A mismatch in turns or mixing low loss type transformers (e.g. "Amorphous Core") with standard types will result in a high circulating current which increases losses and decreases capacity to serve the electric system.

Note: These weights are approximate and are given as comparative information. Actual Unit weights may be found on the Transformer Nameplate. Refer to Transformer Specifications MS 2523, MS 2526 and MS 2541 (Step-downs) for additional information.

Approximate Weights for 1Φ Overhead Transformers (2004)			Overall Height and Weight LIMITS for Standard 1Φ Overhead Transformers per NGRID Specifications MS 2523 and MS 2541		
kVA	**Averaged Lbs. Wt.**		**Size**	**Max. Weight**	**Max. Height**
10	230-280		10 thru 25 kVA	500 (lbs.)	44" (Inches)
25	320-390		37 & 50 kVA	750	48"
50	550-640		75 & 100 kVA	2000	50"
75	850-970		167 &250 kVA	2000	--
100	1250		333 & 500 kVA	3000	--

Supersedes 7/08 Issue – Corrected footer

APPROXIMATE WEIGHT IN POUNDS (OIL INCLUDED) – TRANSFORMERS THROUGH 1992

kVA	1992 – 1989				1988 – 1980				1979 - 1969			
	Dual		15 kV		Dual		15 kV		Dual		15 kV	
	Conv.	CSP	Conv.	CSP	Conv.	CSP	Conv.	CSP	Conv.	CSP	Conv.	CSP
10	270	277	193	203	280	278	225	254	266	338	224	235
15	303	347	224	293	347	343	305	335	381	397	297	330
25	400	416	400	384	413	408	378	413	474	456	360	410
37 ½	510	511	540	550	550	560	343	340	541	544	505	555
50	663	720	740	720	686	719	698	675	651	655	650	705
75	895	903	858	895	903	880	870	975	986	1120	1005	1054
100	1054		1129		990	1350	1013	1060	1280	1330	1140	1160
167	1457		1568		1457		1482		1475		1425	
250			1887				1866				1900	
333			2250				2250				2308	
500			2710				2749				3365	

kVA	1968 - 1962				1961 - 1957		1957 – 1946		1946 - 1937
	Dual		15 kV		5 kV		5 kV		5 kV
	Conv.	CSP	Conv.	CSP	Conv.	CSP	Conv.	CSP	Conv.
5			165	200	205	205	200	220	240
10	255	280	230	250	260	265	260	290	360
15	305	340	270	290	330	340	340	370	420
25	420	450	395	400	455	455	480	520	570
37 ½	570	620	575	620	675	690	720		890
50	670	710	660	720	750	760	850		1160
75	920	1020	910	940	975	995	1130		1350
100	1060	1180	1050	1080	1165	1125	1350		1450
167	1380		1330		1400	1430			
250			1640						
333			2100						
500			3230						

Some of the following drawings contain default **Macro Units (MU)** and **Compatible Units (CU)** in the header for quick reference. These default MU's and CU's are shown with some of the characters in parentheses. These parenthetical characters are variables that help define the exact MU or CU required in STORMS. The definitions of these variables and the method of constructing the required MU and/or CU are shown below.

MACRO UNIT VARIABLES

(U) = 3 Phase Transformer Bank kVA
(W) = 1 Phase Transformer kVA
(X) = Primary Physical Data Code (xxx)
(Y) = Secondary Physical Data Code (xx)
(Z) = Tap Physical Data Code (xx)

Example 1:

MU = @WKXPYSZT
(W) for a 100kVA transformer = **100**
(X) for a 13200GRDY/7620 Primary = **167**
(Y) for a 120/240 V Secondary = **10**
(Z) for a transformer with no taps = **00**

Complete MU = @100K167P10S00T

COMPATABLE UNIT VARIABLES

(E) = Transformer Description (each tank)
15B = 15kVA and Below
25 = 25kVA
37 = 37½ thru 50kVA
75A = 75kVA thru 100kVA
A100 = Above 100kVA
(F) = Secondary Code (3Ø)
2 = 240V and below
4 = above 240V
(U) = 3 Phase Transformer Bank kVA
(X) = Primary Physical Data Code (xxx)
(Y) = Secondary Physical Data Code (xxx)
(Z) = Tap Physical Data Code (xx)

Example 1:

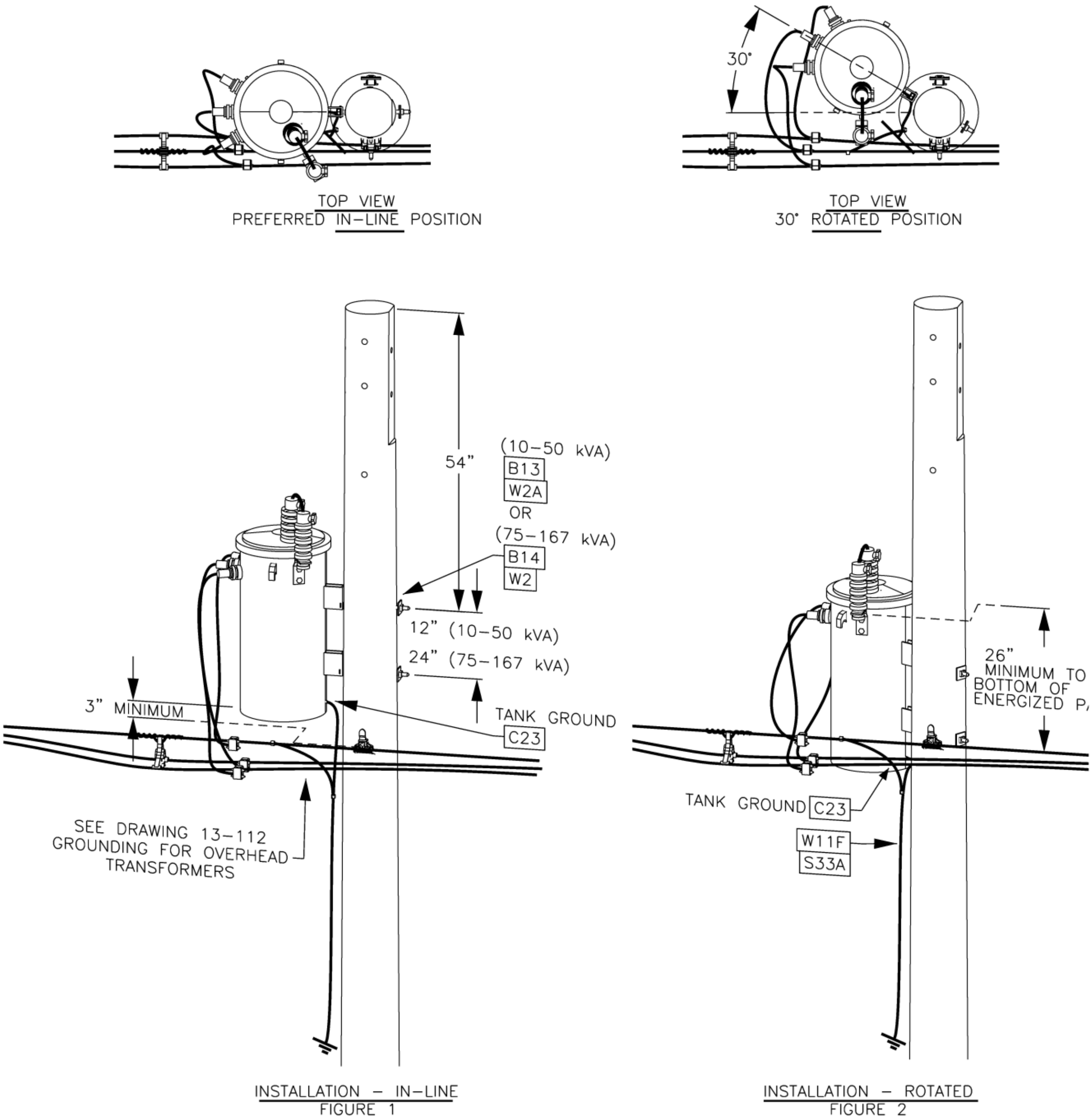
CU for a Transformer = TVWKXPYSZT
(W) for a 100kVA transformer = **100**
(X) for a 13200GRDY/7620 Primary = **167**
(Y) for a 120/240 V Secondary = **10**
(Z) for a transformer with no taps = **00**

Complete CU = TV167P10S00T

Example 2:

CU for a Cluster Mount = TMEFVS
(E) for a 25kVA Transformer = **25**
(F) for a 240V Secondary Voltage = 2

Complete CU = TV252V



NOTE:
1. SEE 14-203 TO 14-271 FOR PRIMARY, SECONDARY AND GROUNDING.
2. SEE PAGE 14-2 FOR PRIMARY AND SECONDARY WIRE SIZE SELECTION.
3. SEE SECTION 17 FOR SPACE ALLOCATION ON JOINT POLES.

Designer	Drawing	Date
MPR	od14121	6/18/21

MOUNTING DETAIL
1Φ TRANSFORMER INSTALLATION

ISSUE	PAGE NUMBER		
7/21	14-121	OVERHEAD CONSTRUCTION STANDARD	ppl

Supersedes 7/09 Issue – Revise drawing to 3-D.

BRACKET SELECTION FOR TRANSFORMERS						
SIZE KVA (EACH TRANSFOMER)	MAX. WEIGHT LBS. (EACH TRANSFOMER)	SUPPORT LUGS *		CLUSTER BRACKET *	ADAPTER PLATE *
		TYPE	SPACING		
10 – 50	500	A	12" (11¼)	T9C	None
75 – 167	2000	B	24" (23¼)	T9D	None
250 – 333	3000	C	24"	T9E	T10
500	2250 – 3000	PLATFORM (36") (SEE 14 – 377)		T6	None

* – REFER TO PAGE 14 – 132 FOR SUPPORT LUGS AND BRACKET DESCRIPTIONS.

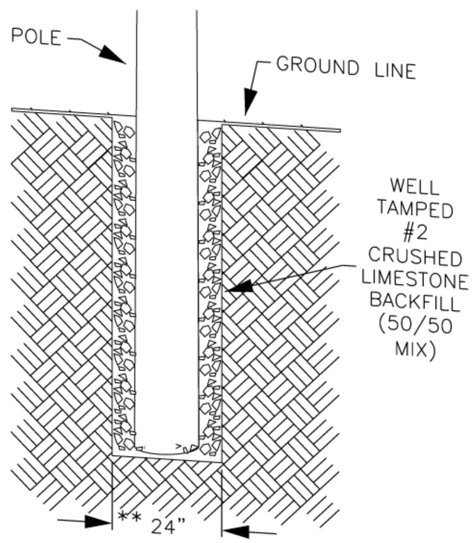


FIGURE I

POLE SETTING DETAIL FOR HEAVY EQUIPMENT (OVER 3000 TOTAL LBS.) OR SOFT SOILS

NOTES:

1. SEE PAGE 14 – 121 FOR MOUNTING SINGLE TRANSFORMERS.
2. FOR SOFT SOIL CONDITIONS OR TRANSFORMERS WEIGHTING MORE THAN 1,000 LBS. EACH, BACKFILL HOLE AS SHOWN IN FIGURE I.

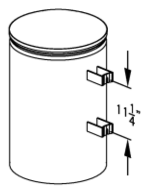
   ALSO USE 8' POLE SETTING DEPTH FOR TRANSFORMERS OF 167 KVA OR LARGER.

   (OVER 4500 TOTAL LBS.)

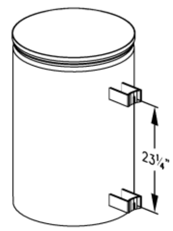
   ** – THE POLE BUTT DIAMETER OF A CLASS 3 POLE IS APPROXIMATELY 12" AND A MINIMUM OF 4" CLEARANCE AROUND POLE BUTT IS RECOMMENDED FOR PROPER BACKFILLING
3. BANKS OF TRANSFOMERS WEIGHTING OVER 2000 LBS. EACH SHALL BE MOUNTED ON PLATFORM (ITEM TMP2) AS SHOWN ON PAGE 14 – 377 AND THE INSTALLATION SHOULD BE LOCATED OUTSIDE TRAFFIC AREAS OR BARRICADED. USE MINIMUM POLE HEIGHT NECESSARY FOR GROUND CLEARANCE AND AVOID DOWN GUYS.
4. SEE PAGE 14 – 80 FOR TYPICAL TRANSFORMER WEIGHTS.

Designer	Drawing	Date
MPR	od14131	6/18/21

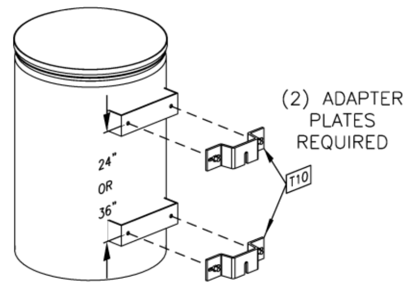
STANDARD SUPPORT LUGS ON OVERHEAD DISTRIBUTION TRANSFORMERS AND REGULATORS



TYPE A LUGS
10–50KVA TRANSFORMERS
USE 5/8" MOUNTNG BOLTS



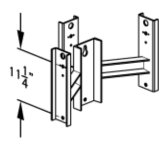
TYPE B LUGS
75–167KVA TRANSFORMERS
USE 3/4" MOUNTNG BOLTS



TYPE C LUGS
250–500KVA TRANSFORMERS
ADAPTER PLATES TO LUGS USE (4) 5/8" BOLTS
ADAPTER PLATES TO POLE USE (2) 3/4" BOLTS

TRANSFORMER CLUSTER BRACKETS

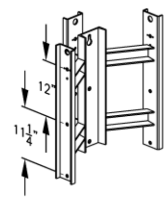
SMALL CLUSTER



UP TO 3–25KVA
USE (2) 5/8" THRU BOLTS *
AND 2 1/4" SQUARE WASHERS

T9C
FOR ALL TYPE A LUGS
11 1/4" SPACING.
500 LBS./POSITION

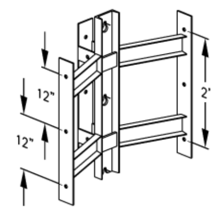
MEDIUM CLUSTER



3–37½KVA TO 3–100KVA
USE (3) 1/2" THRU BOLTS **
AND 3" CURVED WASHERS

T9D
FOR ALL TYPE B LUGS AND MODIFIED TYPE C LUGS WITH 24" SPACING.
2000LBS/POSITION

LARGE CLUSTER



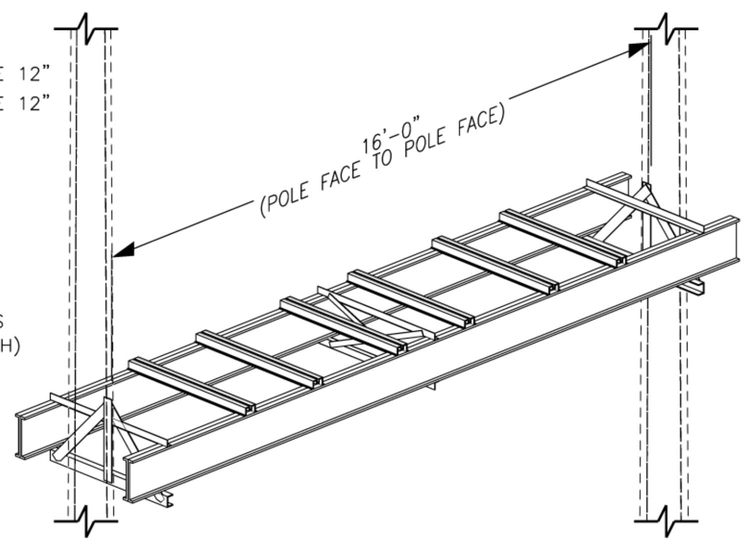
3–167KVA TO 3–333KVA
USE (3) 3/4" THRU BOLTS **
AND 3" CURVED WASHERS

T9E
FOR ALL TYPE B LUGS AND MODIFIED TYPE C LUGS WITH 24" SPACING.
3000LBS/POSITION

* POLE DRILLING –(2) 11/16" HOLES SPACE 12"
** POLE DRILLING –(3) 13/16" HOLES SPACE 12"

ALUMINUM PLATFORM MOUNT

T6
PLATFORM WEIGHT 275LBS.
FOR BANKING 333 & 500KVA TRANSFORMERS
(WEIGHING BETWEEN 2000LBS.–4500LBS. EACH)

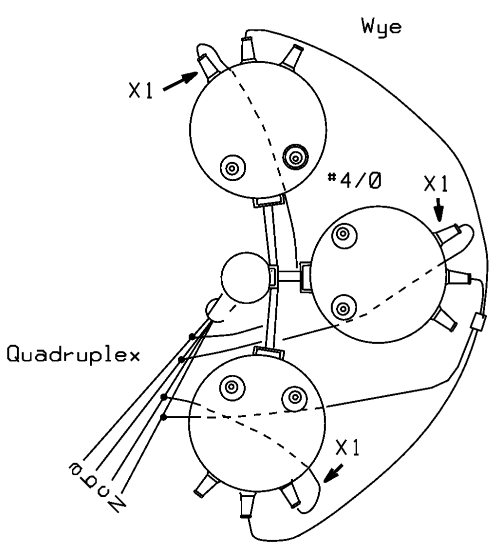


Designer	Drawing	Date
MPR	od14132	3/31/21

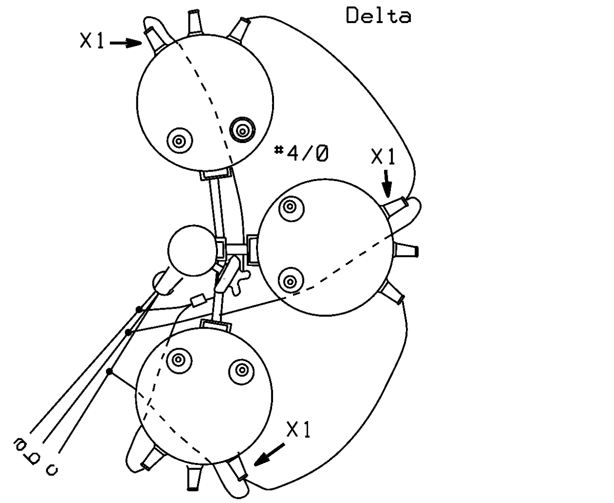
Supersedes 7/17 Issue – Revised drawing to 3-D.

CLUSTER MOUNTS FOR BANKING 3 - 1Φ TRANSFORMERS

ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/21	14-132		



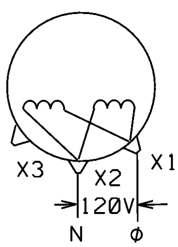
3-25 through 75 KVA
Transformers
4W 208Y/120V Wye Service



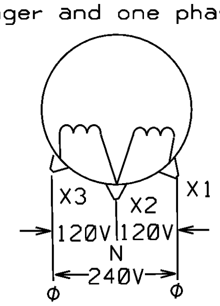
3-25 through 75 KVA
transformers
3W 240 Delta Service

Note:
Secondary voltage test readings (taken with a high-impedence voltmeter) will be inaccurate if low voltage breaker is open on CSP transformers.

Notes:
No modification of internal taps required for delta sevice
Use quadruplex service conductors, as shown in Section 11, bounding the grounded messenger and one phase conductor together.



Internal secondary taps require paralleling.
X3 bushing is unused



Standard series connection winding

Secondary Conductors				
Individual transformer KVA Size	208Y/120 or ✱240 V Service		480Y/277 or ✱480 V Service	
	L.V. CU. Tank wiring	Multiplex service conductor	L.V. CU. tank wire	Multiplex Service Conductor
25	4/0 (W19C)	336.4 (W16E)	#2 (W13E)	#1/0 (W15C)
50	4/0 (W19C)	336.4 (W16E)	4/0 (W19C)	#336.4 (W16E)
75	500 (UC5G)	double 336.4 (16E)	4/0 (W19C)	#336.4 (W16E)

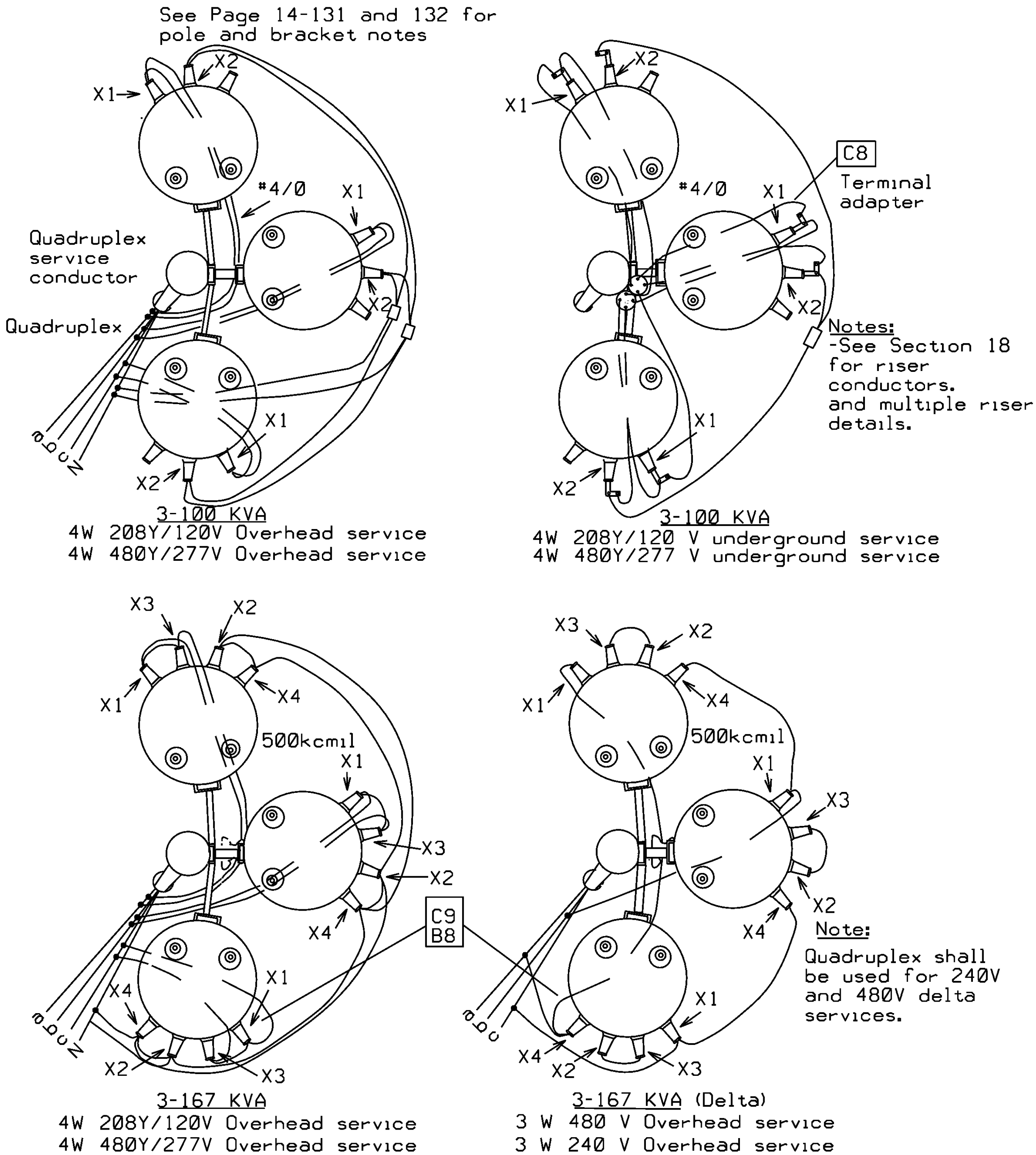
Note: Double (W19C) #4/0 CU may be substituted for single 500 kcmil above.

✱ Shown for information only. This is not a standard service.

See: Section 11 for service connections to buildings.
Page 14-131& 14-132 for cluster mount selection and details.
Section 13 for grounding details.
Page 14-301-326 for 3 primary wiring.

Supersedes 7/08 Issue – Revised table – changed 50kVA transformer wire size for 208Y/120.

Supersedes 7/10 Issue – Added note on selection of dual or single secondary conductor per phases.

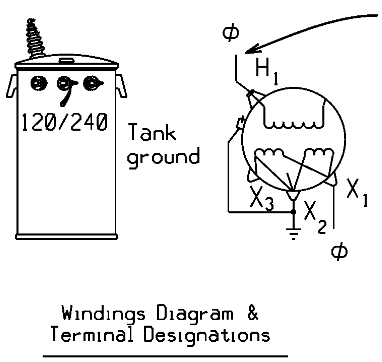


Secondary Conductors		
Individual transformer KVA	L.V. Copper cable size 208Y/120 or 240V	L.V. Copper Cable size 480Y/277 or 480V
3-100 3-167	2-4/0 (W19C) 2-500 (UC5G)	1-4/0 (W19C) 1-500 (UC5G)

Note: For selection of single or dual secondary conductors per phase, refer to table on this page.

3Φ SECONDARY CONNECTIONS
100 – 167 kVA – TOP VIEW

Supersedes 7/08 Issue – Added tank ground and removed tap to phase A in Diagram 2.

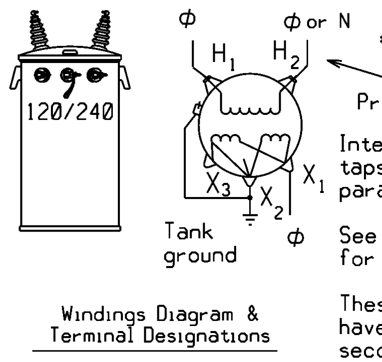


Windings Diagram & Terminal Designations

Internal secondary taps must be paralleled as shown.

See Page 14-2 for wiring sizes.

These transformers have 120/240V secondary rating



Windings Diagram & Terminal Designations

Internal secondary taps must be paralleled as shown.

See Page 14-2 for wiring sizes.

These transformers have 120/240V secondary rating

Diagram 1

Four Wire Grounded Wye Primary

Two-bushing or single bushing transformers

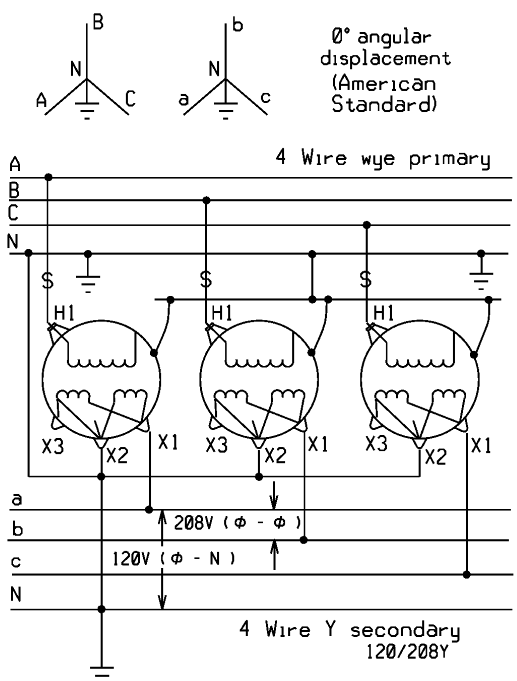
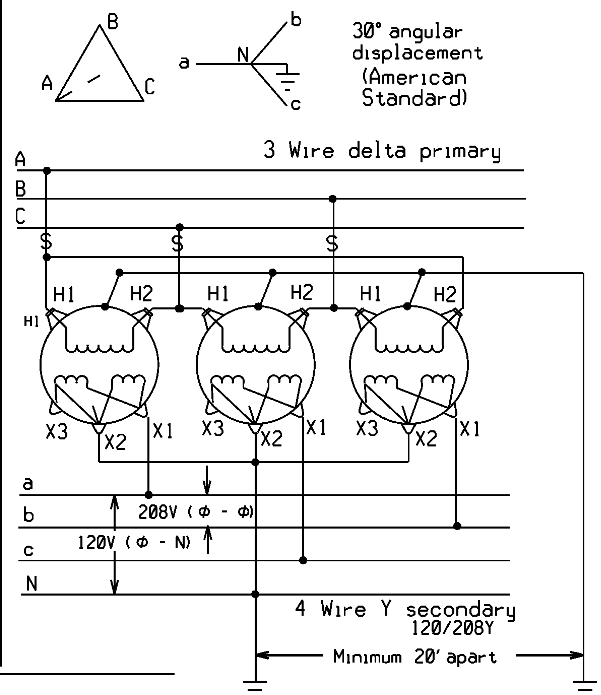


Diagram 2

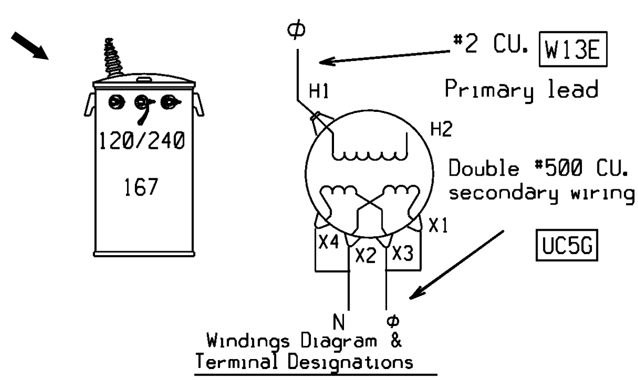
Three Wire Delta Primary

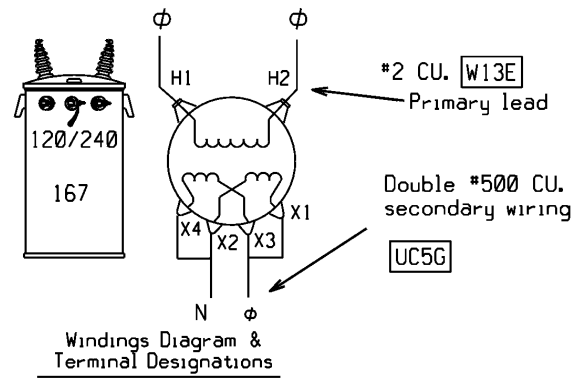
Two bushing transformers



NOTES:

- This information is additional to other information shown in these standards. See 3Φ transformer installation Pages 14-301 through 14-373 for pole top wiring.
- Refer to Pages 13-111 & 112 for transformer grounding details.
- On CSP transformers secondary voltage test readings (taken with a high-impedence voltmeter) will be inaccurate if low-voltage breaker is open on CSP transformers





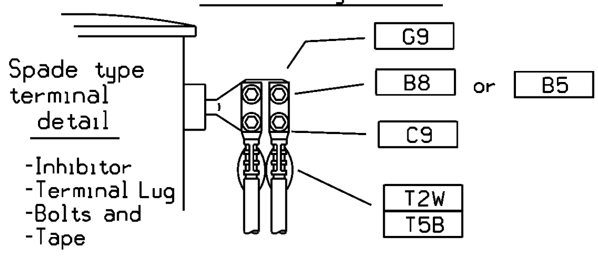
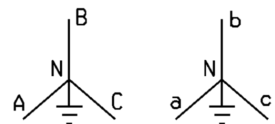


Diagram 3

Four Wire Grounded Wye Primary

Two-bushing or single-bushing transformers



0° angular displacement (American Standard)

Caution: The primary neutral should be tied firmly to the system neutral; otherwise, excessive voltages may develop on the secondary side.

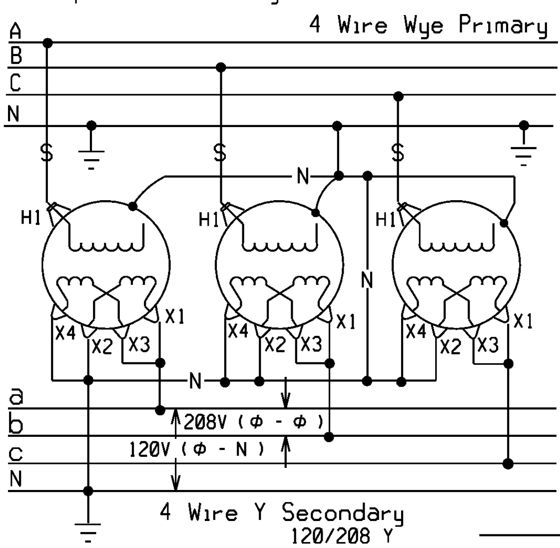
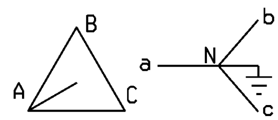


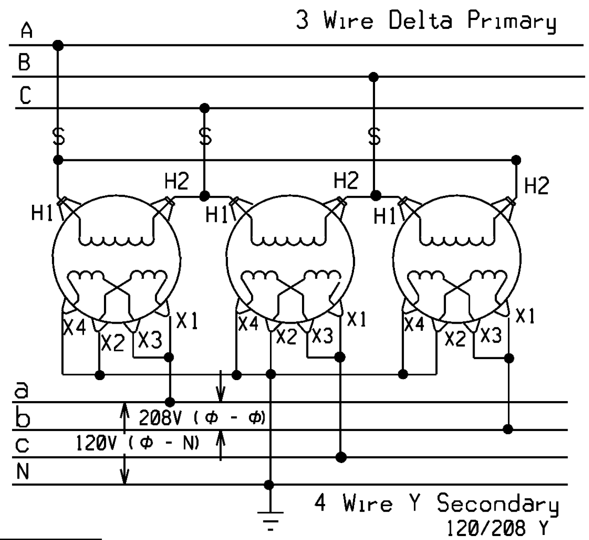
Diagram 4

Three Wire Delta Primary

Two-bushing transformers



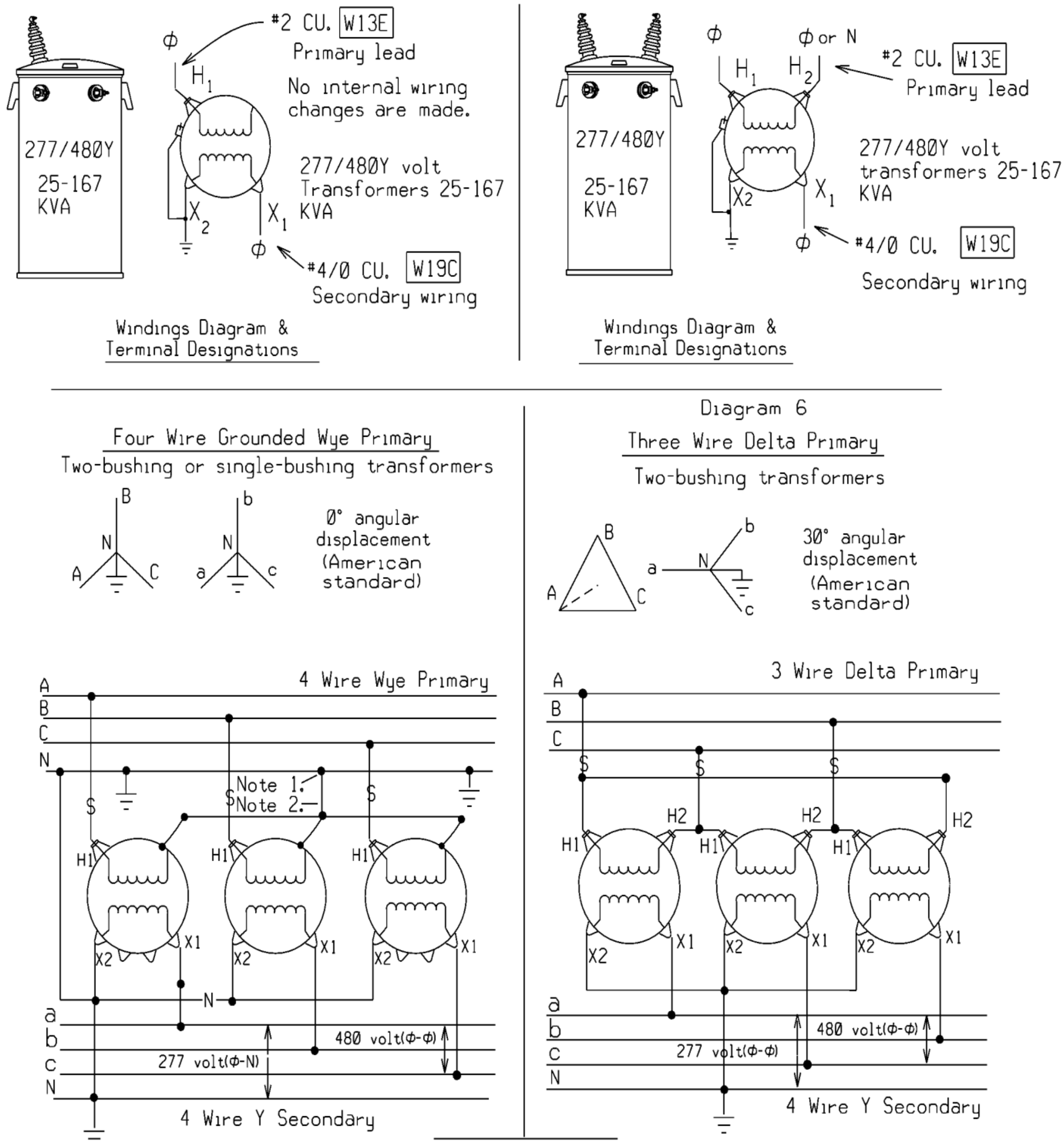
30° angular displacement (American Standard)



Notes:

- 3 wire 240V or 480V delta services are not available for new installations.
- This information is additional to other information shown in these standards. See Page 14-172 for more information on secondary wiring.

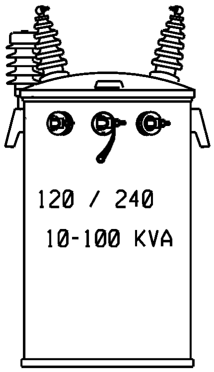
Supersedes 1/06 Issue – Added primary conductor size and correct Diagram 4 wiring

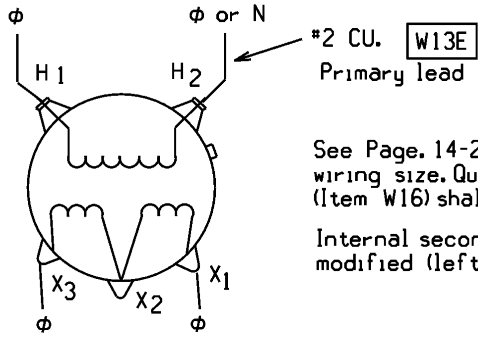


Notes:

1. The primary neutral should be tied firmly to the system neutral; otherwise, excessive voltages may develop on the secondary side.

Supersedes 7/08 Issue – Removed center bushing from drawings.





Windings Diagram & Terminal Designations

See Page. 14-2 for secondary wiring size. Quadruplex conductor (Item W16) shall be used.

Internal secondary taps are not modified (left in series).

Notes:

- This information is supportive of related information shown in these standards.
- See installation Pages 14-304 through 14-373 for pole top wiring.
- Do not use CSP transformers for 3Φ delta secondaries. 240 V & 480 V Delta services are not available for new installations.
- See Section 13 for transformer grounding details.

Diagram 7

Four Wire Grounded Wye Primary

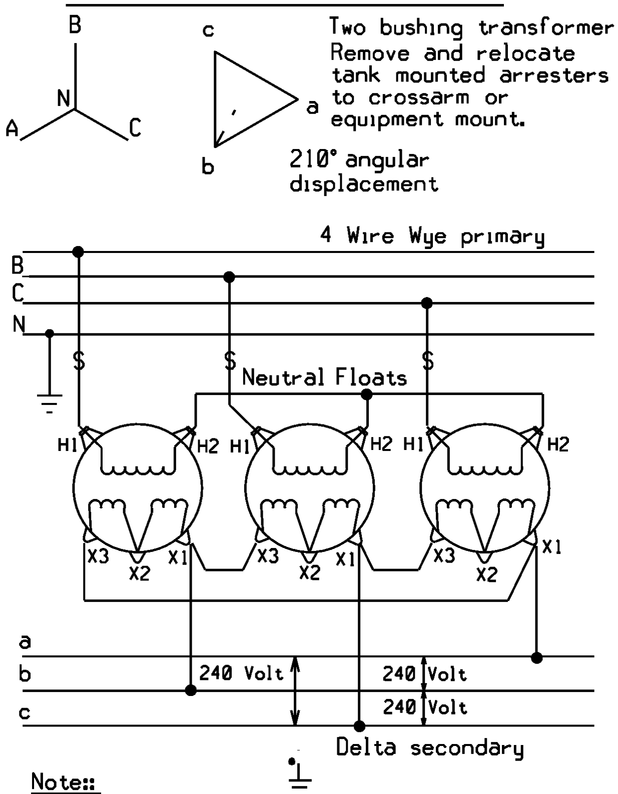
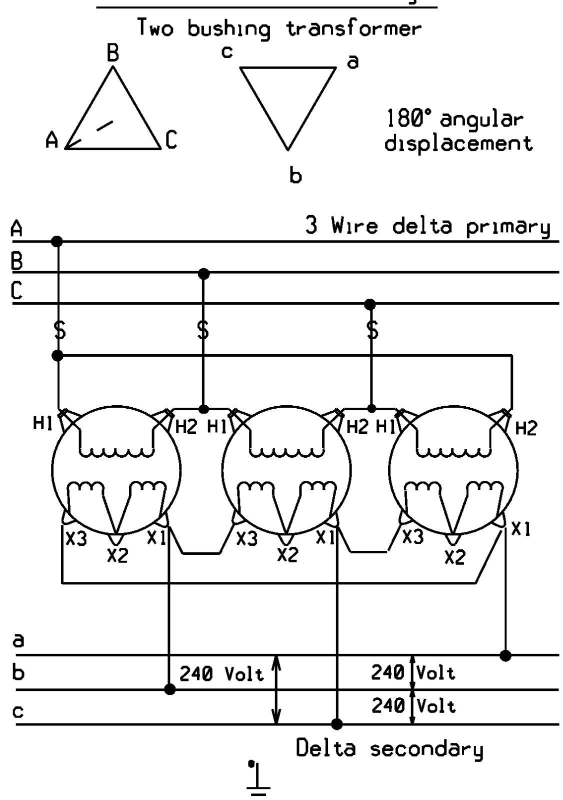


Diagram 8

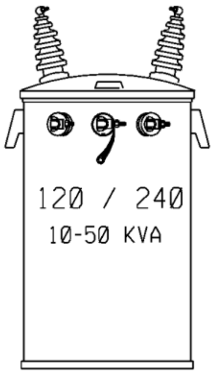
Three Wire Delta Primary

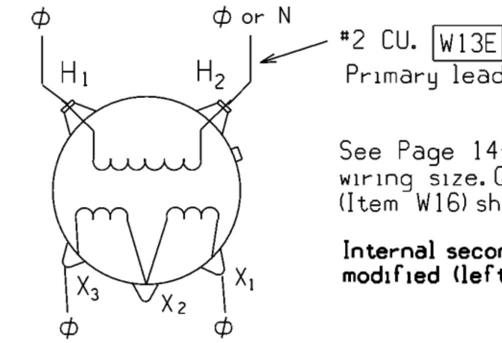


Note::

- The grounding of one phase of the delta secondary has been general practice and is shown on the wiring diagrams for these installations - i.e. figure 4, Page 352. This is not required for performance or safety but may be continued in practice.

Supersedes 7/08 Issue – Moved note regarding arrester location from top of page to Diagram 7





Windings Diagram & Terminal Designations

See Page 14-2 for secondary wiring size. Quadruplex conductor (Item W16) shall be used.

Internal secondary taps are not modified (left in series).

Notes:
- See information regarding these connections on Page 14-7.

Diagram 9
Four Wire Grounded Wye Primary

Two bushing or single bushing transformers

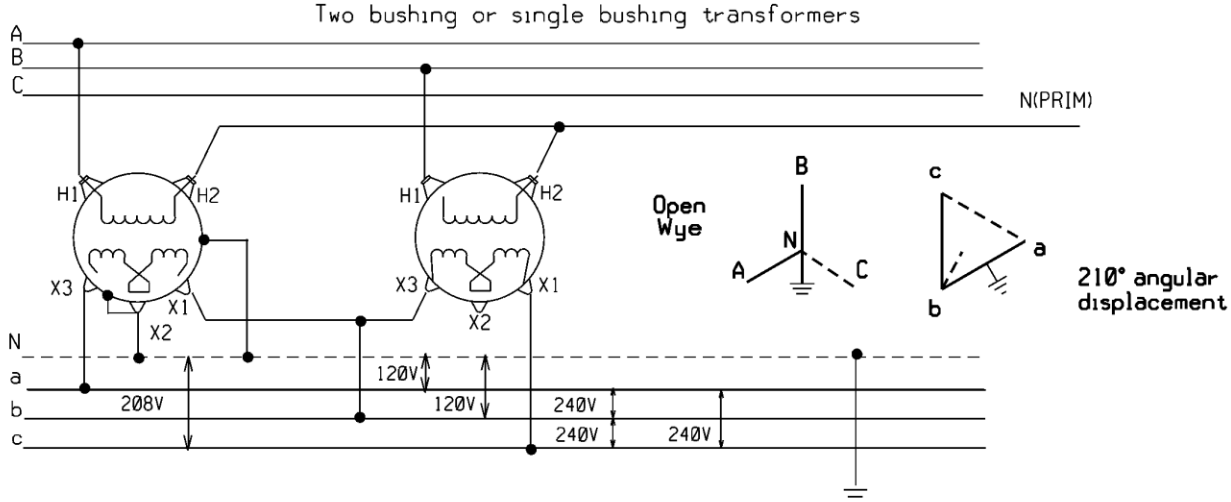
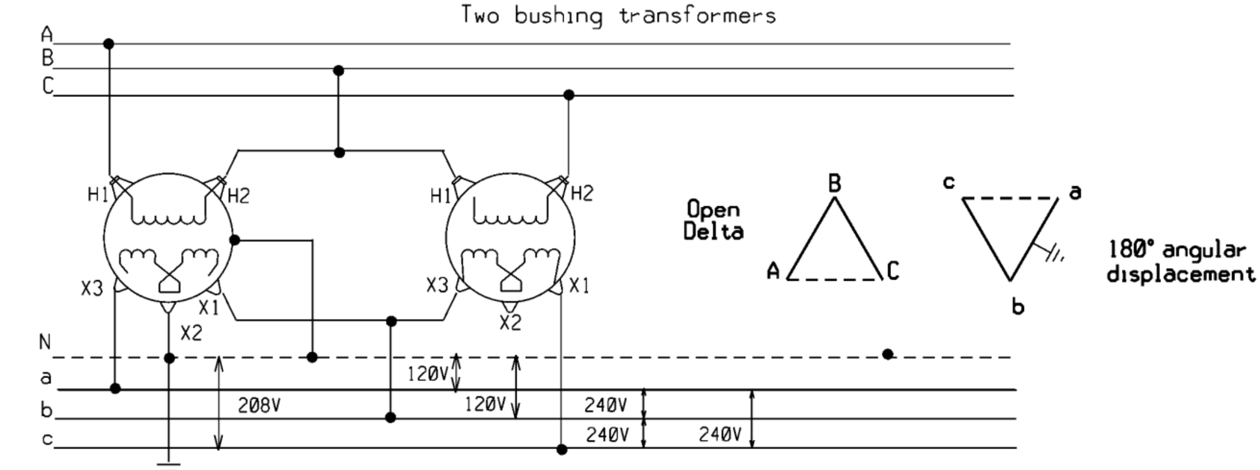
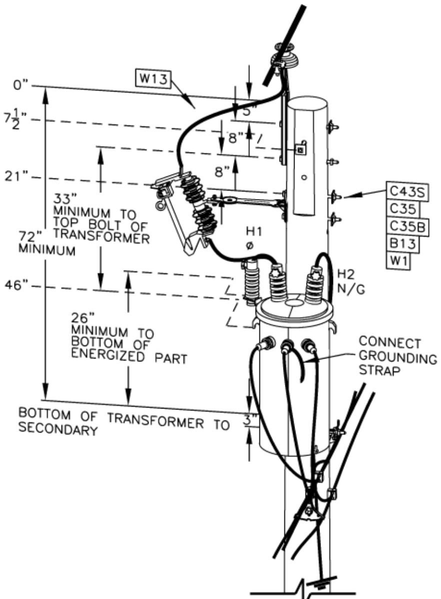


Diagram 10
Three Wire Delta Primary

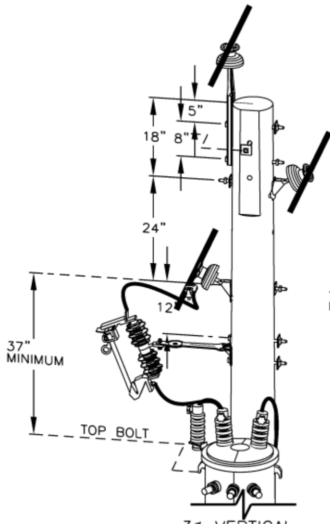
Two bushing transformers



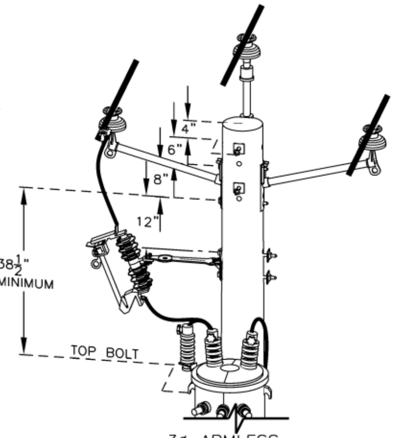
Supersedes 7/10 Issue – Corrected grammar in text describing Diagram 9.



TYPICAL POLE
1Ø POLE TOP
FIGURE 1



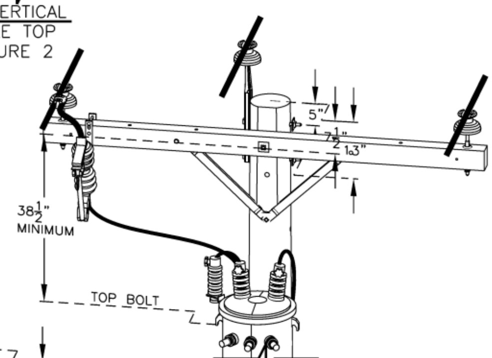
3Ø VERTICAL
POLE TOP
FIGURE 2



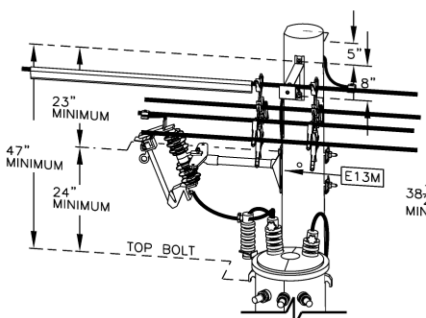
3Ø ARMLESS
POLE TOP
FIGURE 3

NOTES:

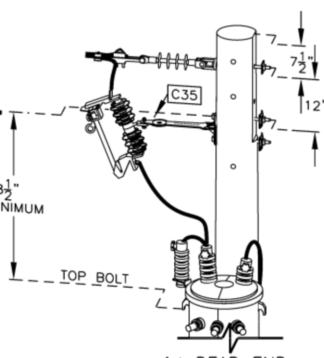
1. SEE 14–121 FOR DETAILS AND MATERIALS FOR MOUNTING TRANSFORMER AND MAKING SECONDARY CONNECTIONS.
2. SEE SECTION 13 FOR GROUNDING DIAGRAMS.
3. SEE SECTION 13 FOR CONVERSION TO 7620V (D.V. UNIT).



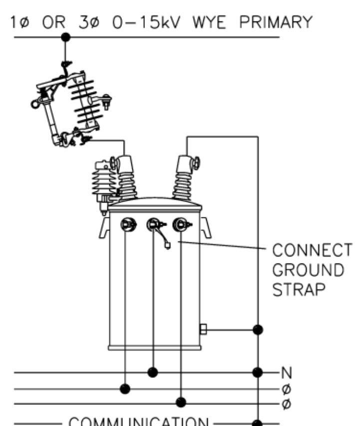
1Ø OR 3Ø
CROSSARM POLE
TOP FIGURE 4



3Ø SPACER
CABLE POLE TOP
FIGURE 5



1Ø DEAD END
FIGURE 6



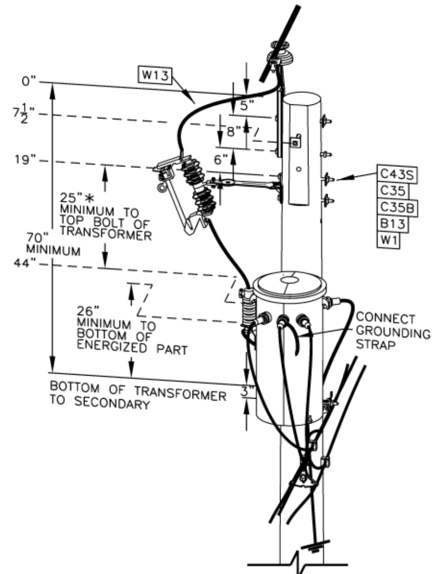
WIRING DIAGRAM
FIGURE 7

Designer	Drawing	Date
MPR	od14204	6/18/21

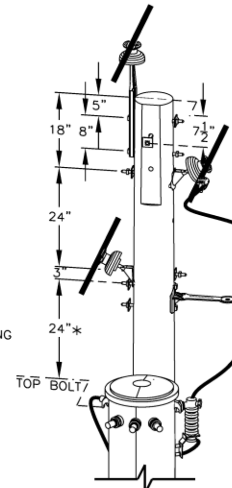
Supersedes 7/12 Issue – Revise drawing to 3-D.

MU = @(W)K(X)P(Y)S(Z)TY	Assembly
CU = TV(W)K(X)P(Y)S(Z)TC	Transformer
***See Page 14-81 For ( ) Variables	

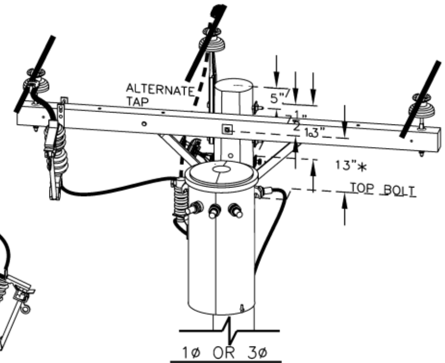
Supersedes 1/06 Issue – Revised drawing to 3-D.



TYPICAL POLE
1Ø POLE TOP
FIGURE 1



3Ø VERTICAL
POLE TOP
FIGURE 2

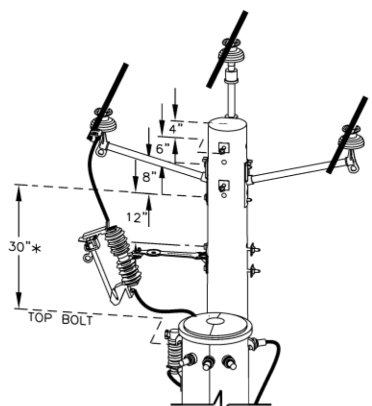


1Ø OR 3Ø
CROSSARM POLE
TOP FIGURE 3

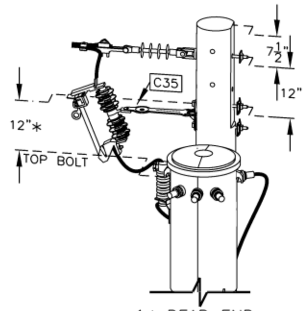
NOTES:

1. SEE 14–121 FOR DETAILS AND MATERIALS FOR MOUNTING TRANSFORMER AND MAKING SECONDARY CONNECTIONS.
2. SEE SECTION 13 FOR GROUNDING DIAGRAMS.

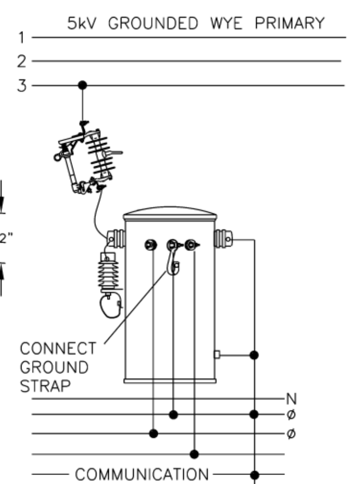
∗ THESE ARE NOMINAL MINIMUMS FOR 0–25 kVA OLD–STANDARD TRANSFORMERS. ALLOW FOR GREATER SPACING PER 15kV DRAWINGS IF CONVERSION IS LIKELY, OR FOR TRANSFORMERS OVER 25 kVA.



3Ø ARMLESS
POLE TOP
FIGURE 4



1Ø DEAD END
FIGURE 5

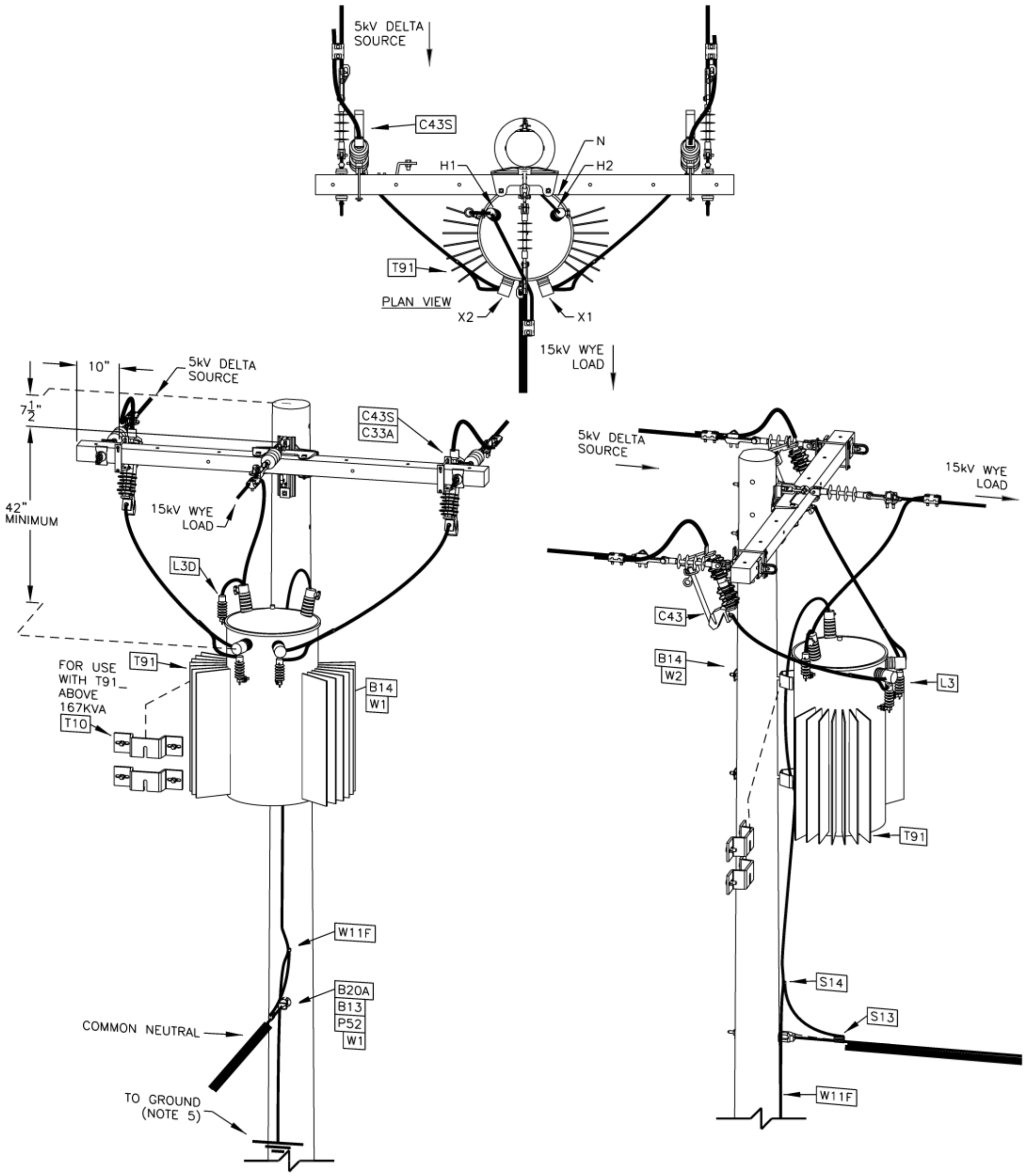


WIRING DIAGRAM
FIGURE 6

Designer	Drawing	Date
MPR	od14212	6/18/21

1Φ CONVENTIONAL TRANSFORMER INSTALLATION
ALL 5 kV WYE CIRCUITS

MU = @(W)K(X)P(Y)S(Z)TD1PRSU	Assembly
CU = TV(W)K(X)P(Y)S(Z)TR	Transformer
***See Page 14-81 For ( ) Variables	



NOTES:

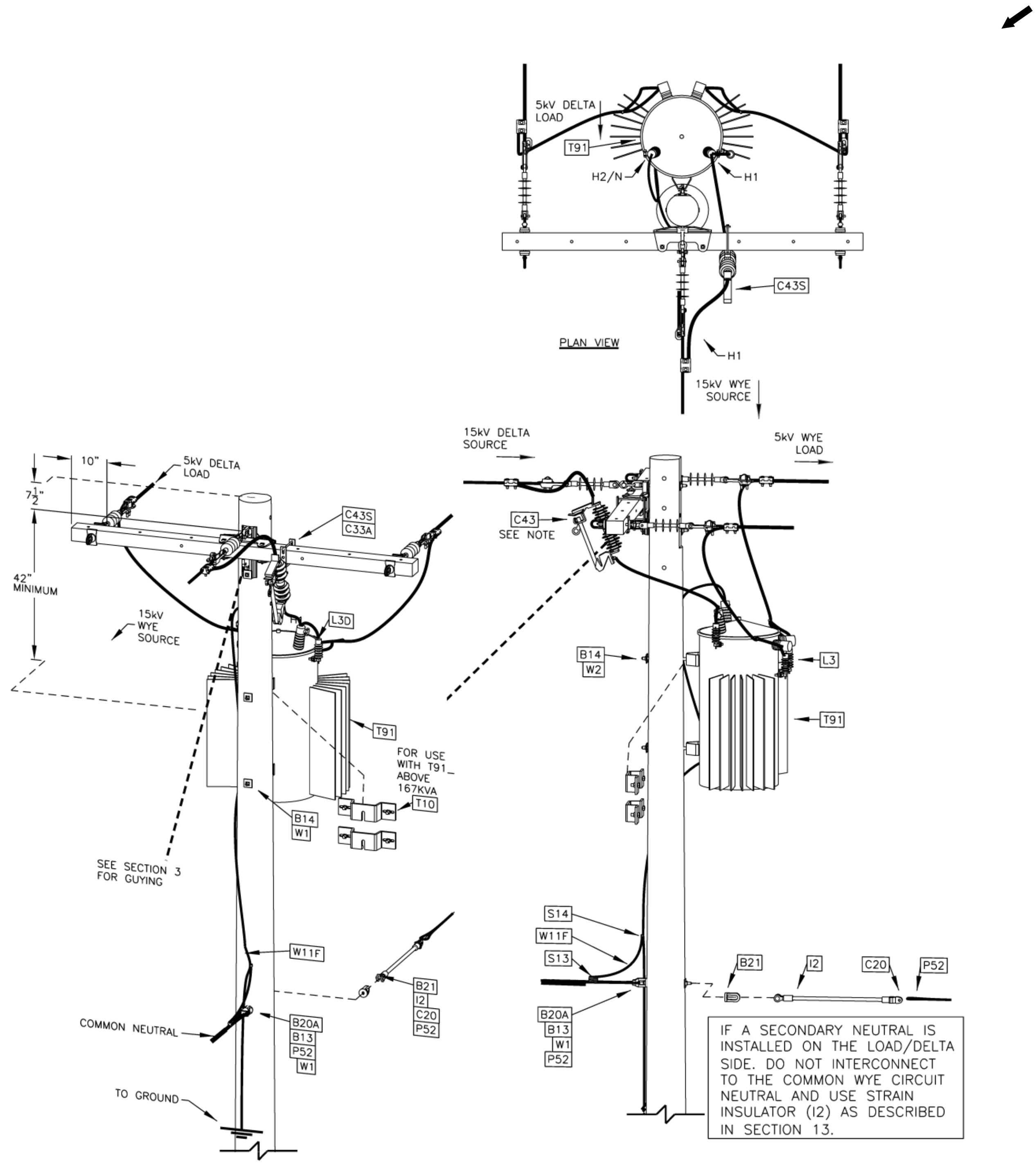
1. TRANSFORMER IS LOCATED TO FACILITATE CUTOUT OPERATION.
2. PLACE CUTOUTS ON SOURCE SIDE. CUTOUTS MAY BE LOCATED ON ADJACENT SOURCE SIDE POLE FOR ADDED SAFETY.
3. TOO HIGH IMPEDANCE TRANSFORMERS (OVER 3.75%) IMPAIR GOOD COORDINATION AND TEND TO INCREASE USE OF LINE REGULATING EQUIPMENT.
4. SEE SECTION 9 FOR DEADEND DETAILS.
5. THE DELTA PRIMARY SYSTEM SURGE ARRESTER GROUNDS MAY BE INTERCONNECTED TO MULTI GROUNDED COMMON NEUTRAL ASSOCIATED WITH GROUNDED WYE PRIMARY CIRCUIT. (REFERENCE NESC RULE 97.B.)

Designer	Drawing	Date
MPR	od14247	6/18/21

Supersedes 7/10 Issue – vise drawing to 3-D.

MU = @(W)K(X)P(Y)S(Z)TY1PR	Assembly
CU = TV(W)K(X)P(Y)S(Z)TR	Transformer
***See Page 14-81 For ( ) Variables	

Supersedes 7/10 Issue – Revise drawing to 3-D.



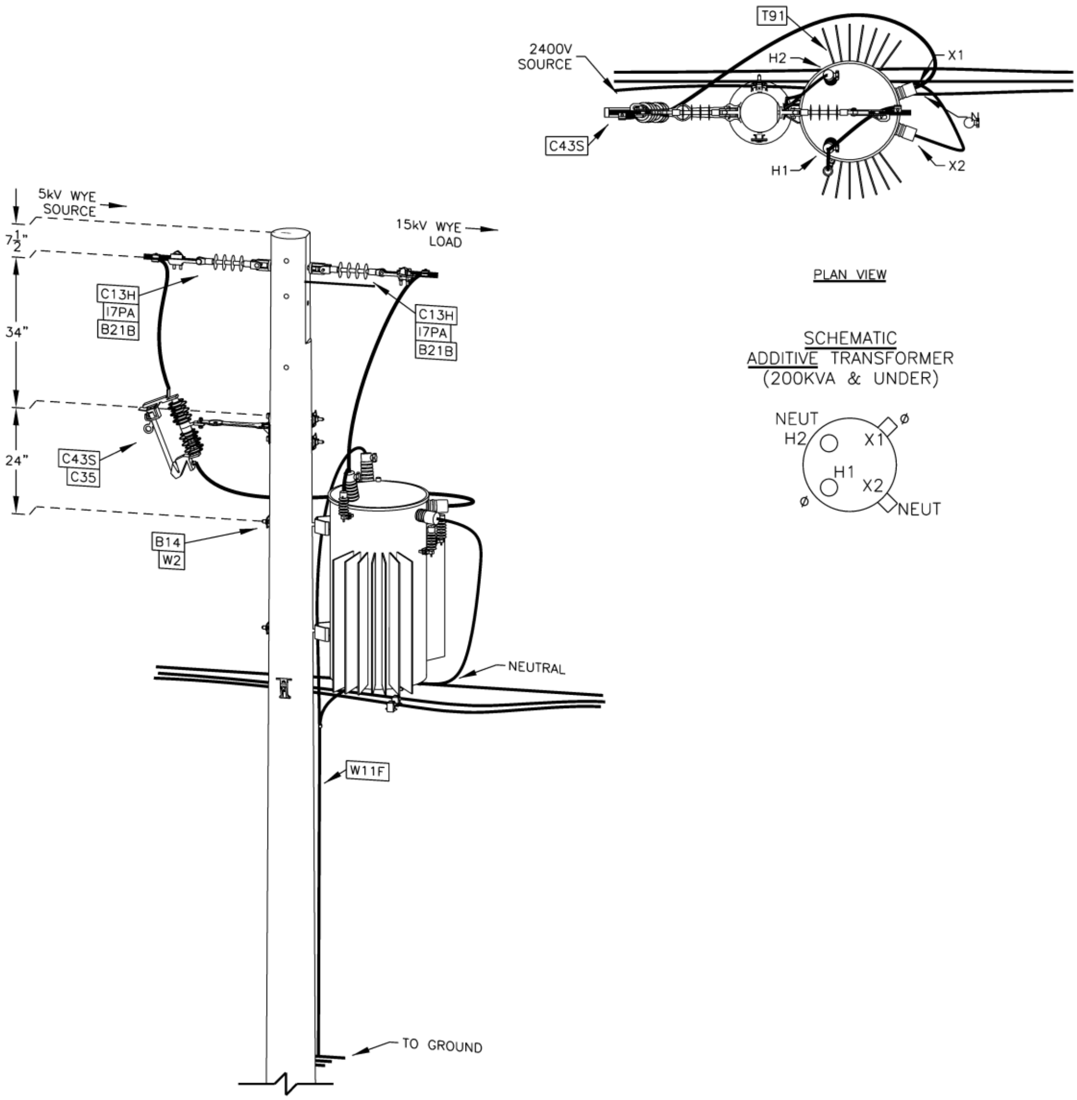
NOTES:

1. FOR ADDED SAFETY, CUTOUT (ITEM C43) MAY BE LOCATED ON ADJACENT SOURCE SIDE POLE.
2. SEE SECTION 9 FOR DEADENDS DETAILS.
3. SEE SECTION 5 FOR CONNECTORS.

Designer	Drawing	Date
MPR	od14248	6/18/21

1Φ TRANSFORMER INSTALLATION
15 kV GROUNDED WYE TO 5 kV DELTA STEP-DOWN INSTALLATION

MU = @(W)K(X)P(Y)S(Z)TY1PRSU	Assembly
CU = TV(W)K(X)P(Y)S(Z)TR	Transformer
***See Page 14-81 For ( ) Variables	



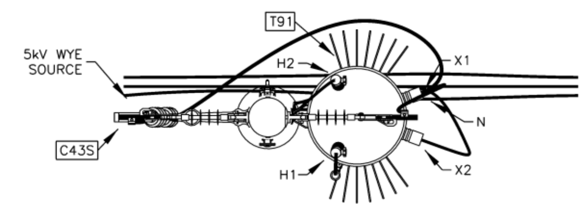
Supersedes 7/10 Issue – Revise drawing to 3-D.

NOTES:
1. SEE SECTION 9 FOR DEADEND DETAILS.
2. SEE SECTION 5 FOR CONNECTORS.

Designer	Drawing	Date
MPR	od14249	6/18/21

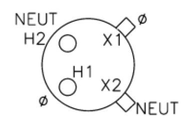
1Φ TRANSFORMER INSTALLATION
5 kV GROUNDED WYE TO 15 kV GROUNDED WYE STEP-UP INSTALLATION

MU = @(W)K(X)P(Y)S(Z)TY1PR	Assembly
CU = TV(W)K(X)P(Y)S(Z)TR	Transformer
***See Page 14-81 For ( ) Variables	

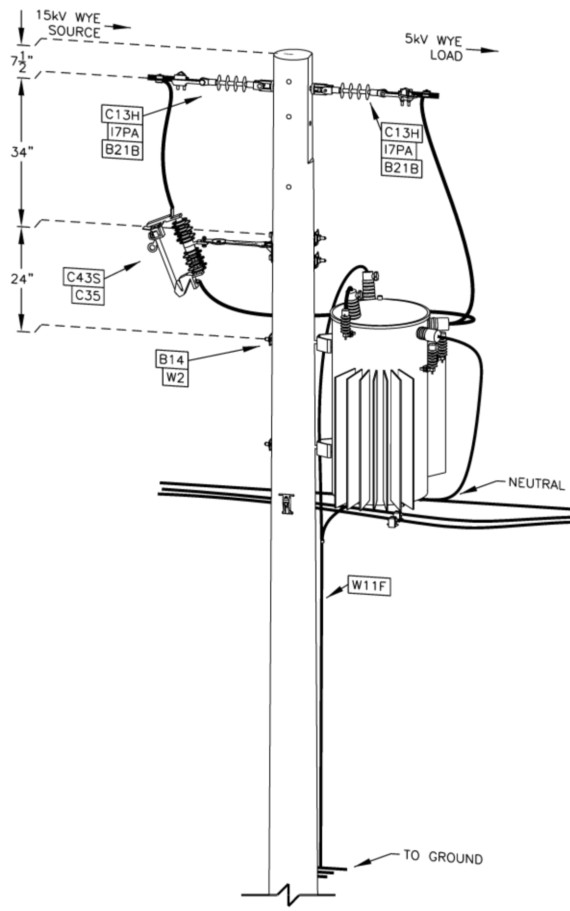


PLAN VIEW

SCHEMATIC
ADDITIVE TRANSFORMER
(200KVA & UNDER)



Supersedes 7/10 Issue – Revised drawing to 3-D.

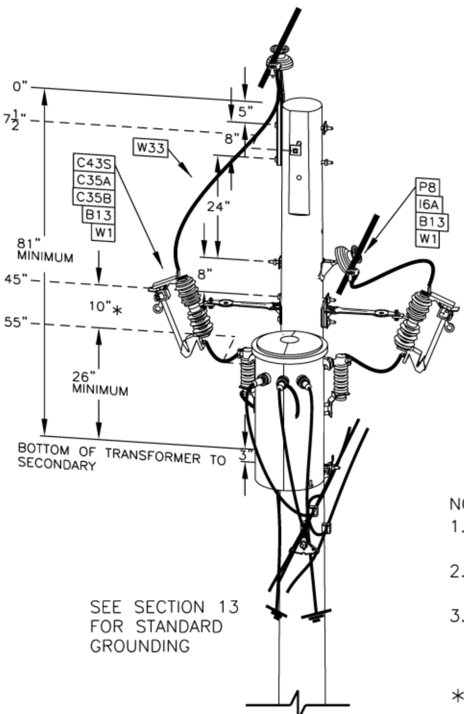


NOTES:

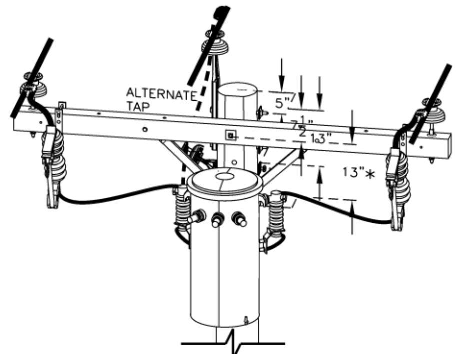
1. SEE SECTION 9 FOR DEADEND DETAILS.
2. SEE SECTION 5 FOR CONNECTORS.
3. FOR ADD SAFETY CUTOUT MAY BE LOCATED ON ADJACENT SOURCE-SIDE POLE.

Designer	Drawing	Date
MPR	od14250	6/18/21

MU = @(W)K(X)P(Y)S(Z)TY1PRSU	Assembly
CU = TV(W)K(X)P(Y)S(Z)TR	Transformer
***See Page 14-81 For ( ) Variables	



TYPICAL POLE
1ø POLE TOP
FIGURE 1

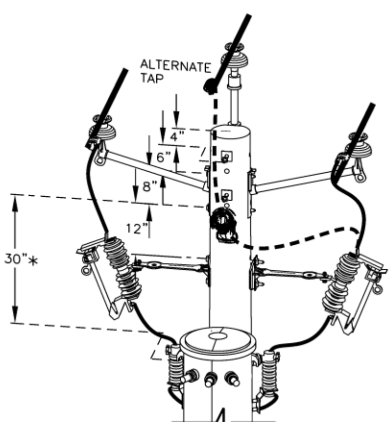


1ø OR 3ø
CROSSARM POLE
TOP FIGURE 2

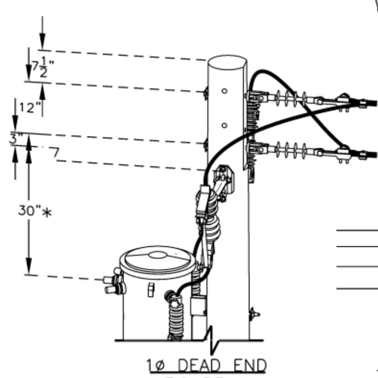
NOTES:

1. SEE 14–121 FOR DETAILS AND MATERIALS FOR MOUNTING TRANSFORMER AND MAKING SECONDARY CONNECTIONS.
2. SEE SECTION 13 FOR STANDARD OVERHEAD TRANSFORMER GROUNDING DIAGRAMS.
3. SURGE ARRESTERS ARE GROUNDED THROUGH THE TRANSFORMER TANK GROUND AND ISOLATED FROM THE SECONDARY NEUTRAL GROUND BY REMOVING THE GROUNDING STRAP BETWEEN THE SECONDARY NEUTRAL AND THE TANK.

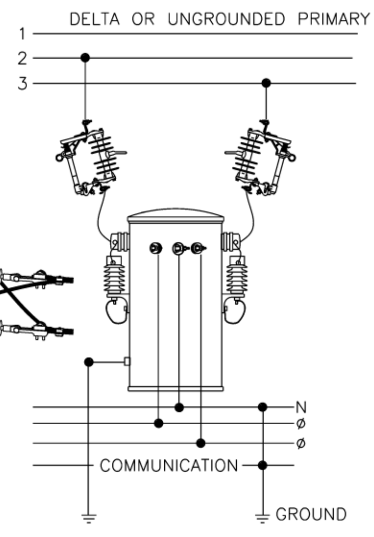
* THESE ARE NOMINAL MINIMUMS FOR 0–25kVA OLD-STANDARD TRANSFORMERS. ALLOW FOR GREATER SPACING PER 15kV DRAWINGS IF CONVERSION IS LIKELY, OR FOR TRANSFORMERS OVER 25kVA.



3ø ARMLESS
POLE TOP
FIGURE 3



1ø DEAD END
FIGURE 4

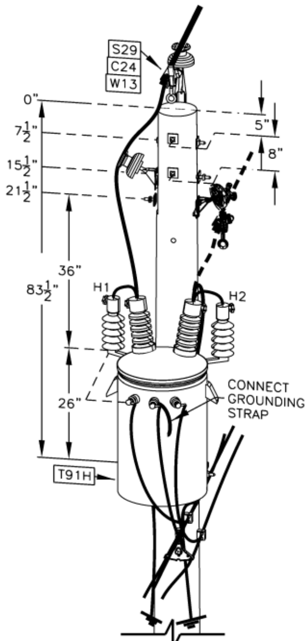


120/240V WIRING DIAGRAM
FIGURE 5

Designer	Drawing	Date
MPR	od14252	6/18/21

Supersedes 7/10 Issue – Revised drawing to 3-D.

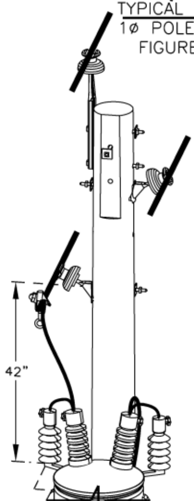
1Φ CONVENTIONAL TRANSFORMER INSTALLATION 5 kV DELTA OR UNGROUNDED WYE



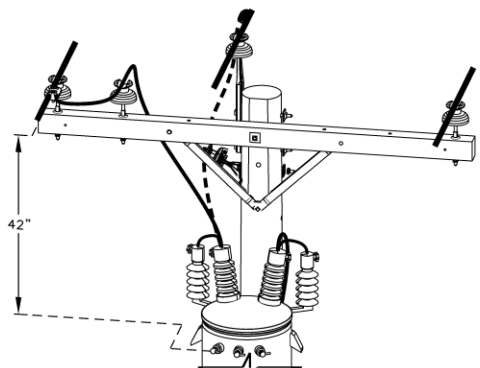
TYPICAL POLE
1Ø POLE TOP
FIGURE 1

TRANSFORMER CONVERSION STEPS

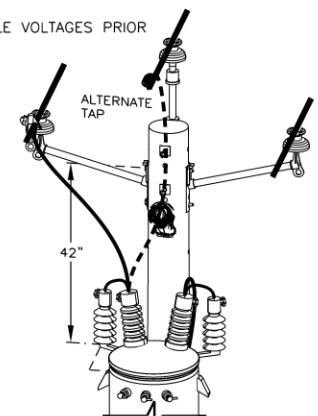
1. ESTABLISH THE MULTIGROUNDED COMMON NEUTRAL SYSTEM (PER SECTION 13.4).
2. REFER TO NG EOP D010 PRIMARY CIRCUIT /TRANSFORMER VOLTAGE CONVERSIONS FOR ADDITIONAL SAFETY AND WORK METHODS FOR VOLTAGE CONVERSIONS.
3. DE-ENERGIZE SECTION OF FEEDER TO BE CONVERTED BY FOLLOWING EOP D010 AND EOP D002.
4. OPEN THE SECONDARY BREAKER OF CSP TRANSFORMER IF EQUIPPED.
5. REMOVE THE SECONDARY TANK DISCHARGE GAP IF INSTALLED.
6. LIGHTING ARRESTER ON THE PRIMARY BUSHING THAT WILL BE USED FOR THE NEUTRAL MAY BE LEFT IN PLACE.
7. IF TRANSFORMER WAS CONNECTED TO A DELTA PRIMARY SYSTEM REMOVE THE TRANSFORMER PRIMARY LEAD FROM THE PRIMARY CONDUCTOR TO THE H2 BUSHING SO THAT IT CAN BE USED AS THE NEUTRAL CONNECTION ON THE WYE SYSTEM.
8. USING A CONTINUOUS #4 CU. WIRE (STD ITEM # W11F) CONNECT THE TERMINAL ON THE PRIMARY BUSHING (H2) THAT WILL BE USED FOR THE NEUTRAL CONNECTION OF THE TRANSFORMER TO THE GROUND STUD FROM WHICH THE SECONDARY TANK DISCHARGE GAP HAS BEEN REMOVED TO THE SECONDARY NEUTRAL WHICH IS NOW THE COMMON NEUTRAL. IF IT IS IMPRACTICAL TO USE A CONTINUOUS WIRE, COMPRESSION CONNECTORS (STD ITEM # S23 OR STD ITEM # S14 FOR COPPER TO COPPER CONDUCTORS AND STD ITEM # S13 FOR COPPER TO ALUMINUM OR STEEL CONDUCTORS) SHALL BE UTILIZED FOR ANY SPLICES OR TAPS. BOLTED CONNECTORS SHALL NOT BE USED TO SPLICE OR BOND GROUND WIRES.
9. INSTALL A GROUNDING STRAP OR CONDUCTOR FROM THE TRANSFORMER SECONDARY NEUTRAL BUSHING TO THE TRANSFORMER TANK. NOTE: GROUNDING STRAPS SHALL NOT BE CONNECTED ON THREE PHASE WYE-DELTA WIRED TRANSFORMER BANKS WITH 240-VOLT DELTA OR 480 VOLT DELTA SECONDARY VOLTAGES.
10. BOND THE DOWN GROUND CONDUCTOR TO THE GROUNDED COMMUNICATION COMPANY MESSENGER. IF THERE ARE TWO EXISTING DOWN GROUND CONDUCTORS, THEY SHALL BOTH BE BONDED TO THE NEUTRAL AND ONE BOND MADE TO THE COMMUNICATION COMPANY MESSENGER. NOTE: COMMUNICATION COMPANY SHOULD BE ADVISED THAT A CONVERSION WOULD BE TAKING PLACE BEFORE THIS STEP IS TAKEN.
11. VERIFY THAT THE PRIMARY LEAD IS CONNECTED TO THE CORRECT PHASE ACCORDING TO THE JOB CONSTRUCTION WORK ORDER.
12. CHANGE THE DUAL VOLTAGE SWITCH TO THE CORRECT POSITION.
13. OPEN PRIMARY CUTOUT AND RE-FUSE AS INSTRUCTED BY ENGINEERING OR DISTRIBUTION DESIGN AND CLOSE IT BACK IN. NOTE: IN HIGH AVAILABLE FAULT CURRENT AREAS FOLLOW CURRENT LIMITING FUSE REQUIRES FOUND IN SECTION 12.4.20
14. AFTER PRIMARY IS RE-ENERGIZED CHECK FOR ACCEPTABLE VOLTAGES PRIOR TO ENERGIZING CUSTOMERS LOAD.



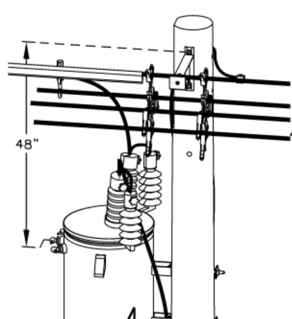
3Ø VERTICAL
POLE TOP
FIGURE 2



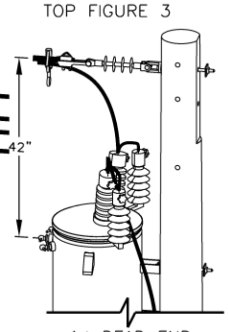
1Ø OR 3Ø
CROSSARM POLE
TOP FIGURE 3



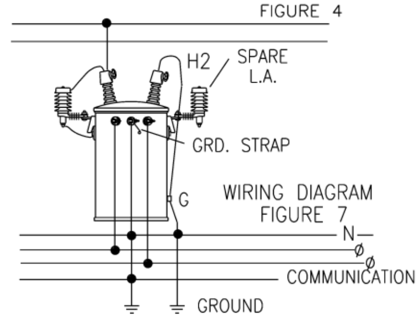
3Ø ARMLESS
POLE TOP
FIGURE 4



SPACED CABLE
FIGURE 5



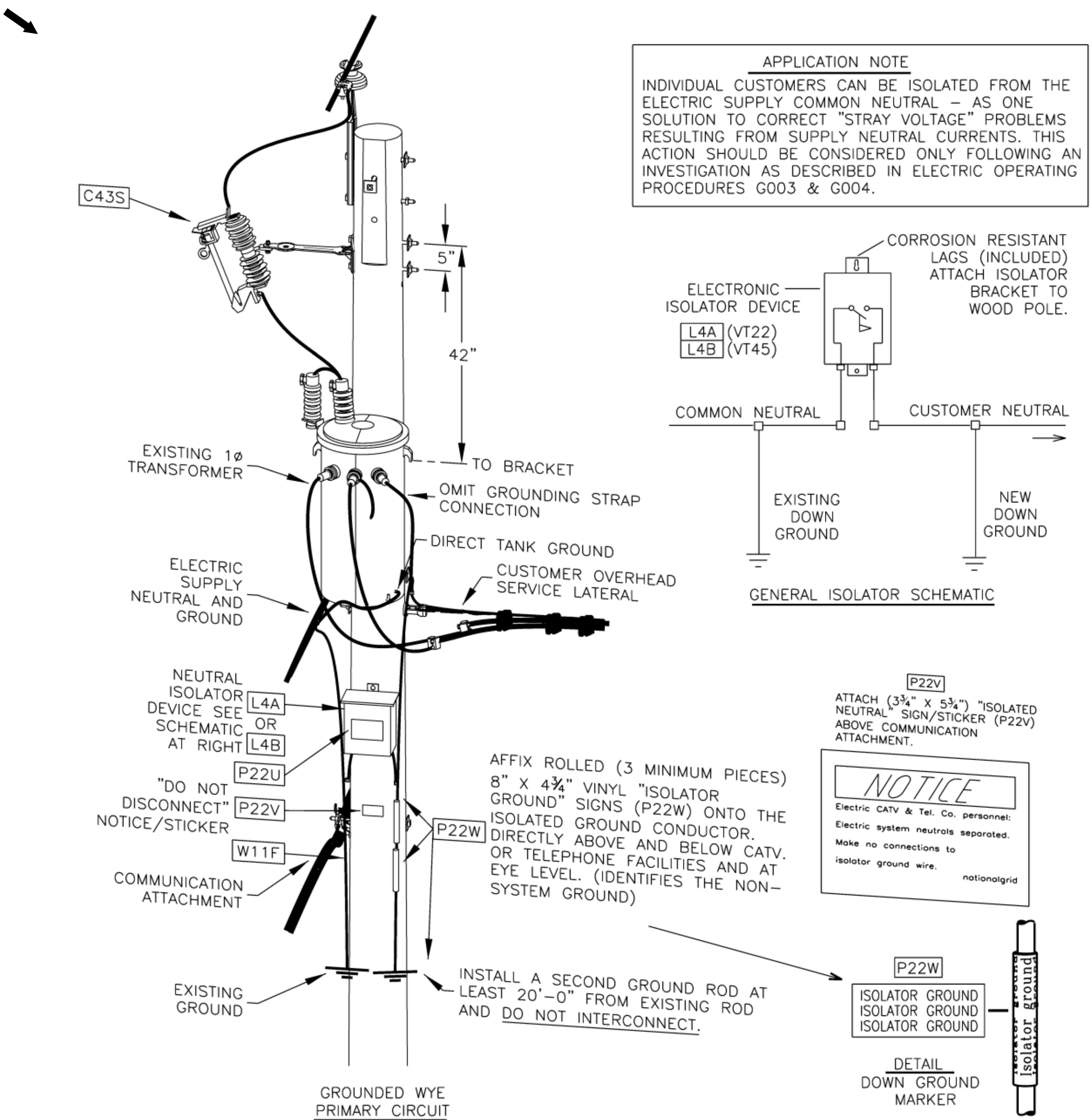
1Ø DEAD END
FIGURE 6



WIRING DIAGRAM
FIGURE 7

Designer	Drawing	Date
MPR	od14263	6/18/21

CONVERSION OF DUAL-VOLTAGE CSP TRANSFORMERS FROM 5 kV TO 15 kV



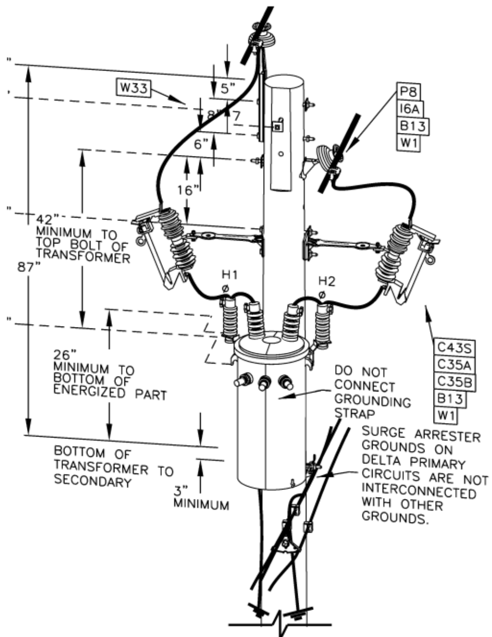
Designer	Drawing	Date
MPR	od14264	6/18/21

Supersedes 1/06 Issue – Revised drawing to 3-D.

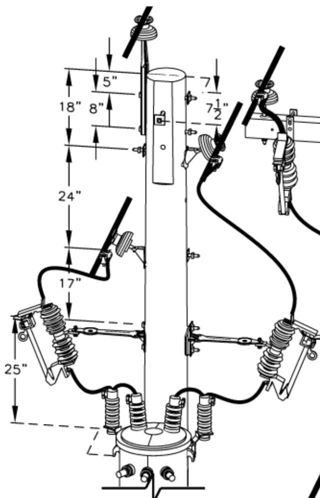
ISOLATED NEUTRAL TRANSFORMER CONNECTION FOR CUSTOMERS AFFECTED BY NEUTRAL TO EARTH POTENTIAL – WYE CIRCUITS

MU = @(W)K(X)P(Y)S(Z)TD	Assembly
CU = TV(W)K(X)P(Y)S(Z)TC	Transformer
***See Page 14-81 For ( ) Variables	

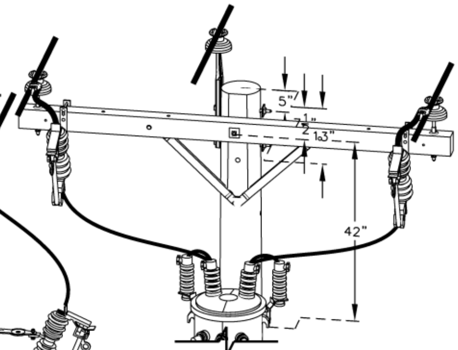
Supersedes 7/08 Issue – drawing to 3-D.



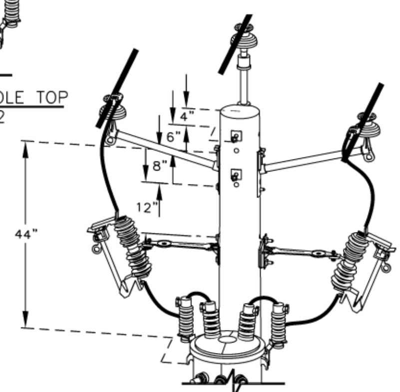
TYPICAL POLE 1ø POLE TOP
FIGURE 1



3ø VERTICAL POLE TOP
FIGURE 2

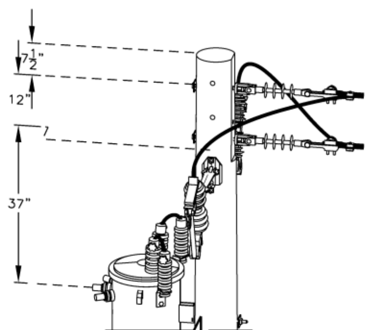


1ø OR 3ø CROSSARM POLE TOP
FIGURE 3

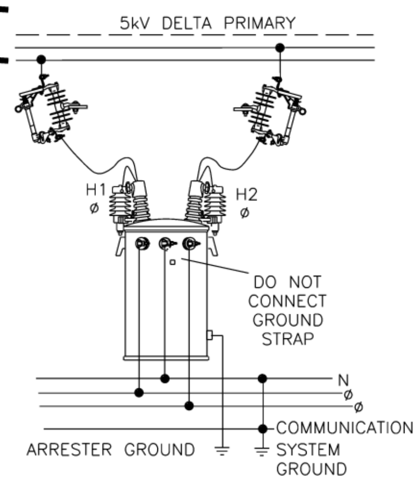


3ø ARMLESS POLE TOP
FIGURE 4

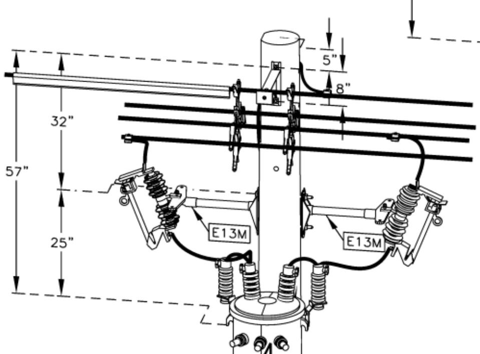
NOTES:
1. SEE 13–112 FOR STANDARD TRANSFORMER GROUNDING.
2. SEE 14–121 FOR DETAILS AND MATERIALS FOR MOUNTING TRANSFORMER AND MAKING SECONDARY CONNECTIONS.
3. SEE SECTION 13 FOR CONVERSION TO 7620V.



1ø DEAD END
FIGURE 6



WIRING DIAGRAM
FIGURE 7



3ø SPACER CABLE POLE TOP
FIGURE 5

Designer	Drawing	Date
MPR	od14271	6/18/21

1Φ CONVERSION OF DUAL-VOLTAGE TRANSFORMERS
ALL 5 kV DELTA CIRCUITS

The Drawings on the following pages show Pole Top Details for the Most Common installation of Transformers in three phase banks. Cluster mounts are recommended as the standard installation for individual transformers weighing up to 2,000 pounds each

The following Notes apply to the Three-Phase Drawings on Page 14-304 through 14-378:

1. For details of Secondary Wiring on three banks, see Page 14-2 and Pages 14-171 & 14-172.

2. Transformers exceeding 2000 pounds each should be mounted on a Platform arrangement as shown on 14-377. Typical Weights are given on Page 14-80. Unit weight of any specific transformer can be found on the nameplate.

3. One vertical Grounding Conductor shall be installed at each bank (as at every equipment installation). This shall be solidly connected from the driven ground to the Secondary or Common neutral. It shall also be bonded or interconnected to any Communication Messenger present on the pole. It shall be (except as described in Note 4.) connected to the Surge Arrester grounds and to the transformer tanks as indicated on the Drawings.

4. A second vertical Grounding Conductor is required for Arrester Grounds on Delta Primary Circuits. This grounding conductor connects the arresters to a second driven ground without any interconnections. The two ground rods shall be separated by 20' or more (6' minimum required) and not bonded together.

5. Banks of 300 kVA or more shall be located outside of heavy traffic area. Transformers may be rotated 90° as required.

6. Banks should not exceed three 100 kVA transformers for 208Y/120V Services or three 167 kVA transformers for 480Y/277V Services. Services larger than this shall be served by non-pole-mounted installations. Services exceeding 800A are not recommended.

7. Additional information pertaining to transformer installations is shown in other Sections of these standards. For Selection of Service Conductors see Section 11. Fusing Selection for Overhead Conventional Transformers is found on Section 12. Standard Grounding arrangements for Overhead Transformers are shown in Section 13 and other Grounding and Bonding notes are found throughout section 13.

8. See Section 5 for information on Connectors and Section 10 for Transformer Connections to Multiplex Secondaries.

9. Wye-Delta connected transformer installations that require a floating Primary Neutral shall require Double Bushing Transformers. These Floating Wye-Delta connected transformers SHALL NOT have direct-connected tank-mounted arresters.

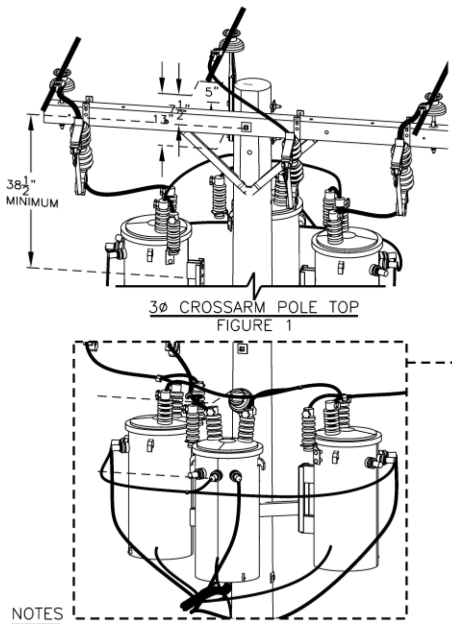
   The tank mounted arresters shall be Removed and separately mounted (i.e. Crossarm-mounted) on the same pole and connected at the source-side of the Fused Cutout. Arresters, otherwise, could become subjected to damaging induced overvoltages during operation of the cutout (if located on the load side of cutout).

10. For Existing CSP transformer banks, when it is necessary to replace a CSP unit with a conventional unit, Cutouts with appropriate fuse link shall be installed on all units.

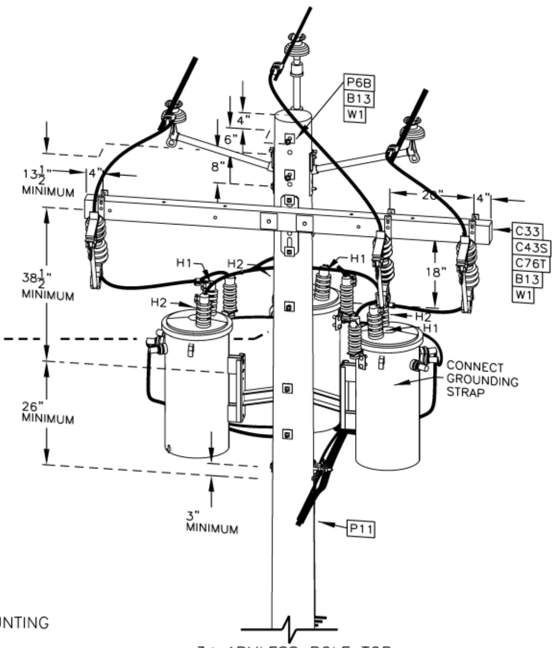
Supersedes 1/08 Issue – Corrected page title

MU = @(U)K(X)P(Y)S(Z)TY	Assembly
CU = TV9W)K(X)P(Y)S(Z)TC	Transformer
CU = TMC(E)(F)VSNE	Cluster Mount
***See Page 14-81 For ( ) Variables	

Supersedes 7/18 Issue – vised drawing to 3-D.



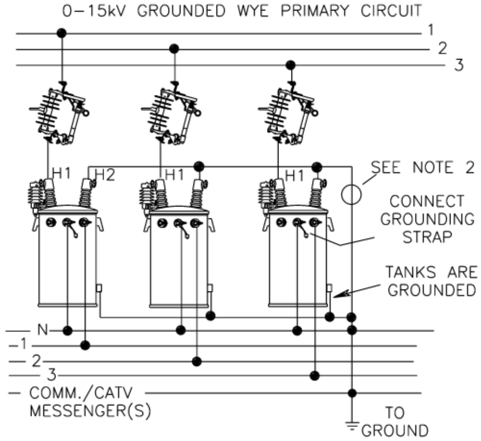
3Ø CROSSARM POLE TOP
FIGURE 1



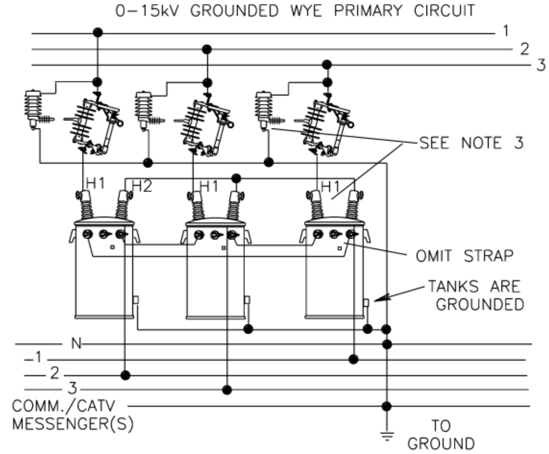
3Ø ARMLESS POLE TOP
FIGURE 2

NOTES

1. SEE PAGE 14–121 FOR DETAILS & MATERIALS FOR MOUNTING TRANSFORMER AND MAKING SECONDARY CONNECTIONS.
2. SURGE ARRESTER GROUNDS ARE NOT INTERCONNECTED WITH ANY OTHER MULTI–GROUNDS ON DELTA PRIMARY CIRCUITS.
3. FLOATING WYE DELTA INSTALLATIONS (FIGURE 4) MUST HAVE ARRESTERS REMOVED FROM THE TANK AND RELOCATED AHEAD OF THE CUTOUT ONTO A BRACKET OR CROSSARM FOR PROTECTION OF THE ARRESTER FROM DAMAGING OVER VOLTAGES INDUCED DURING SWITCH OPERATIONS (OPENING/ENCLOSING OF ITS ASSOCIATED CUTOUT).



480Y/277V OR 208Y/120V
WIRING DIAGRAM
FIGURE 3

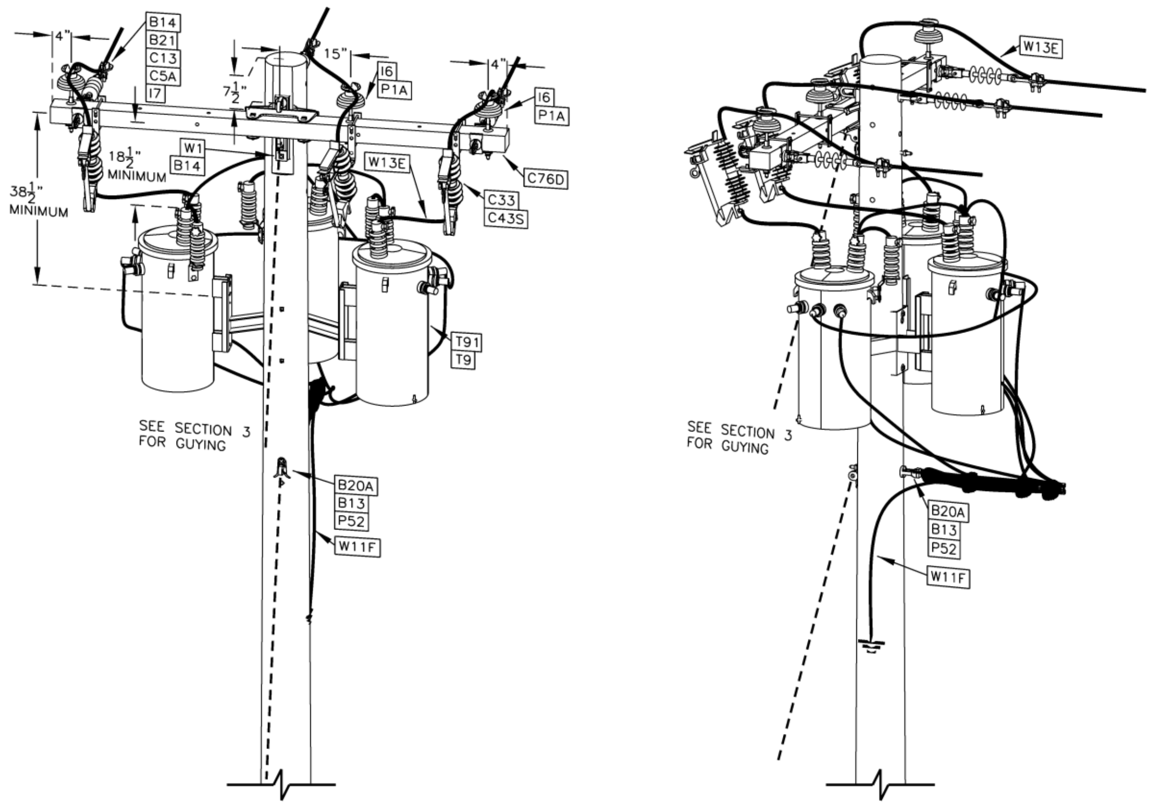


240V WIRING DIAGRAM
FIGURE 4

Designer	Drawing	Date
MPR	od14304	6/18/21

3Φ CONVENTIONAL TRANSFORMER INSTALLATION ALL 15 kV WYE CIRCUITS

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	14-304	7/21



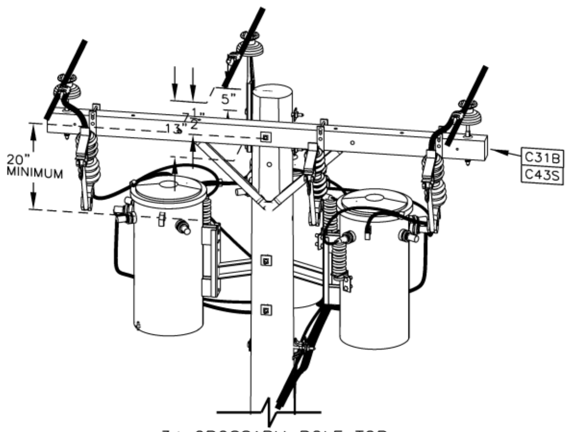
NOTES

1. INSTALLATIONS ON 15kV GROUNDED WYE CIRCUITS, WHERE FAULT CURRENT 7500A., REQUIRE CURRENT LIMITING FUSES PER SECTION 12
2. SEE SECTION 13 FOR GROUNDING DETAILS.
3. SEE 14–304, 14–312 AND 14–371 FOR WIRING DIAGRAMS, AND 14–171 AND 14–172 FOR SECONDARY CONNECTIONS.

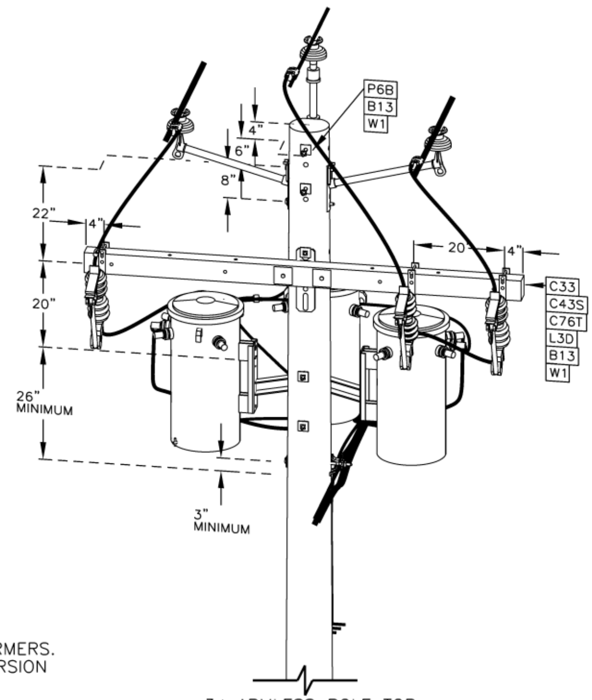
Supersedes 7/12 Issue – Revised drawing to 3-D.

Designer	Drawing	Date
MPR	od14305	6/18/21

MU = @(U)K(X)P(Y)S(Z)TY	Assembly
CU = TV9W)K(X)P(Y)S(Z)TC	Transformer
CU = TMC(E)(F)VSNE	Cluster Mount
***See Page 14-81 For ( ) Variables	



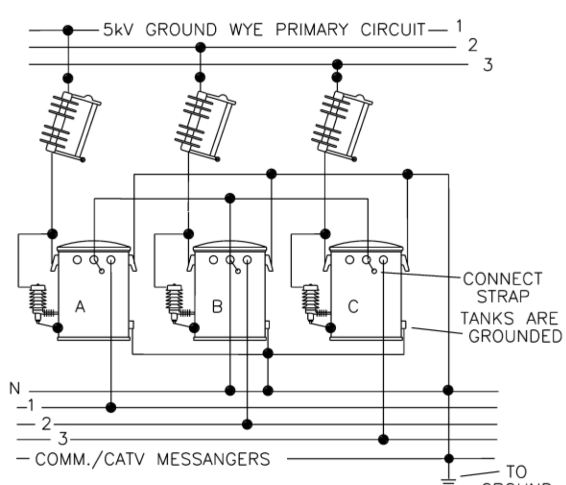
3Ø CROSSARM POLE TOP
FIGURE 1



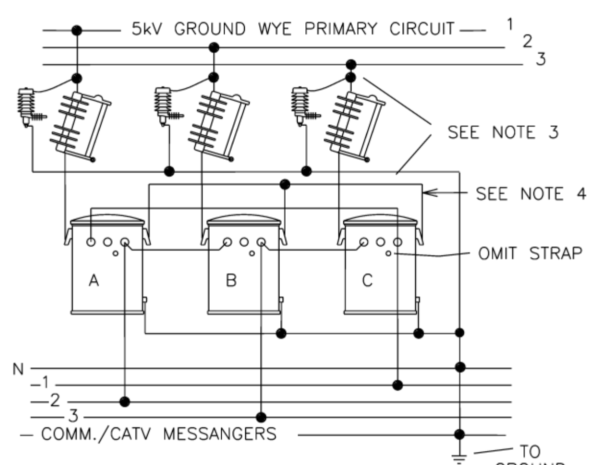
3Ø ARMLESS POLE TOP
FIGURE 2

NOTES

1. THESE ARE NOMINAL MINIMUMS FOR 0–25 KVA TRANSFORMERS. ALLOW GREATER SPACING PER 15KV DRAWINGS IF CONVERSION IS LIKELY OR FOR TRANSFORMERS OVER 25 KVA.
2. FOR 480V DELTA SERVICE, PROVIDE A 480Y/277V. 4 WIRE SERVICE PER FIGURE 3.
3. REMOVE THE TANK–MOUNTED ARRESTERS AND RELOCATE THEM TO A BRACKET OR CROSSARM AND CONNECT TO THE SOURCE SIDE OF THE CUTOUTS.
4. NEUTRAL FLOATS ON TRANSFORMERS SUPPLYING DELTA SERVICE FROM WYE PRIMARY.



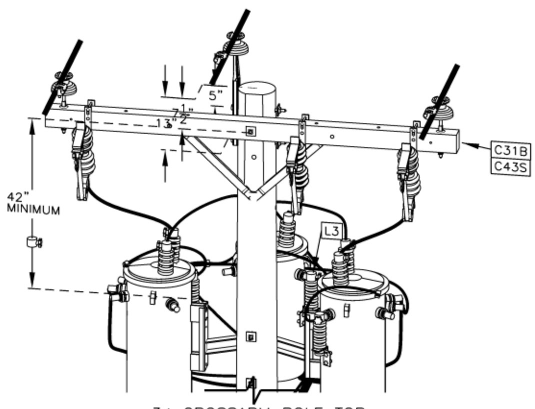
480Y/277 OR 208Y/120V
WIRING DIAGRAM FIGURE 3



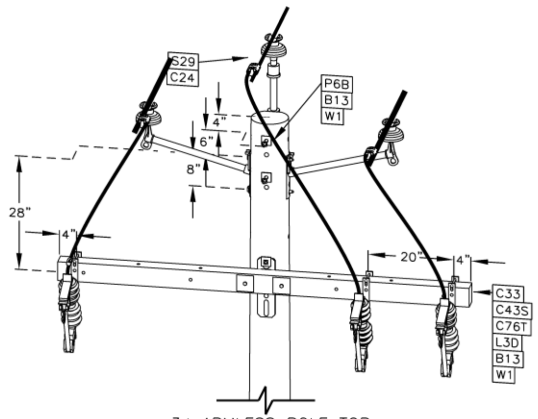
240V
WIRING DIAGRAM FIGURE 4

Designer	Drawing	Date
MPR	od14312	6/18/21

MU = @(U)K(X)P(Y)S(Z)TY	Assembly
CU = TV(W)K(X)P(Y)S(Z)TC	Transformer
CU = TMC(E)(F)VSNE	Cluster Mount
***See Page 14-81 For ( ) Variables	



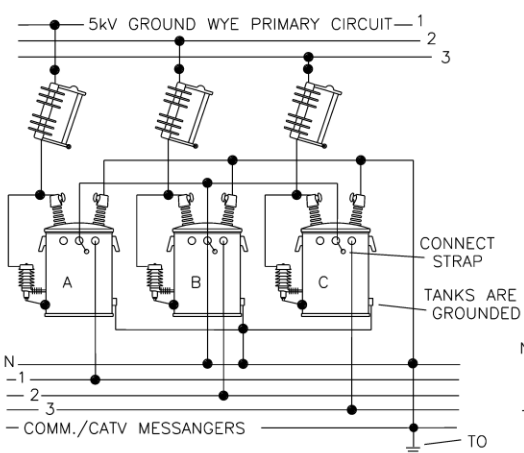
3Ø CROSSARM POLE TOP
FIGURE 1



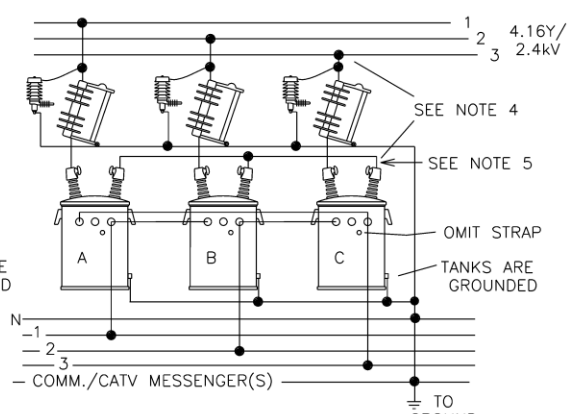
3Ø ARMLESS POLE TOP
FIGURE 2

NOTES:

1. SEE PAGE 14-131 & 132 FOR MOUNTING TRANSFORMERS AND PAGES 14-173 & 176 FOR WIRING DIAGRAMS.
2. SEE SECTION 9 FOR PRIMARY POLE TOPS WHICH MAY TAKE LESS POLE SPACE OR USE ALTERNATE ARRANGEMENTS BELOW FOR REUSING EXISTING 35' POLES, SEE PAGE 14-292 FIGURES FOR CLEARANCES BEFORE CONVERTING.
3. FOR 480V DELTA SERVICE, PROVIDE A 480Y/277V, 4 WIRE SERVICE PER FIGURE 3.
4. REMOVE THE TANK-MOUNTED ARRESTERS AND RELOCATE THEM TO A BRACKET OR CROSSARM AND CONNECT TO THE SOURCE SIDE OF THE CUTOUTS FOR 240V SERVICE.
5. NEUTRAL FLOATS ON TRANSFORMERS SUPPLYING DELTA SERVICE FROM WYE PRIMARY.



480Y/277 OR 208Y/120V
WIRING DIAGRAM FIGURE 3

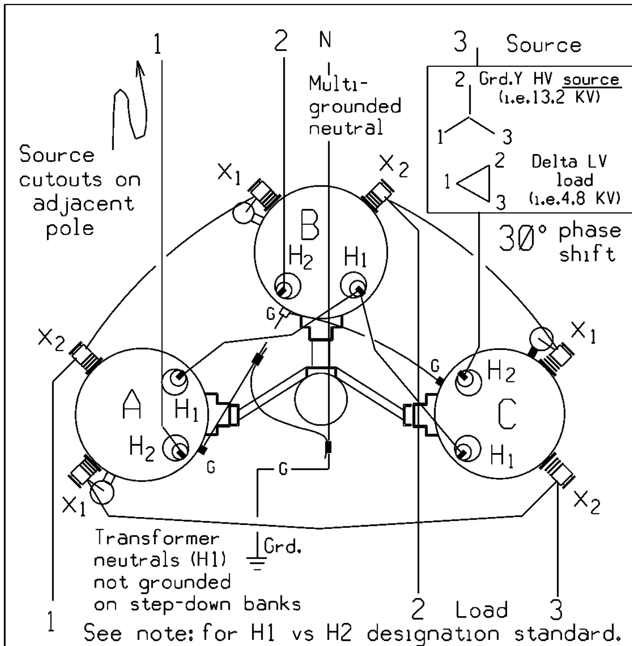


240V
WIRING DIAGRAM FIGURE 4

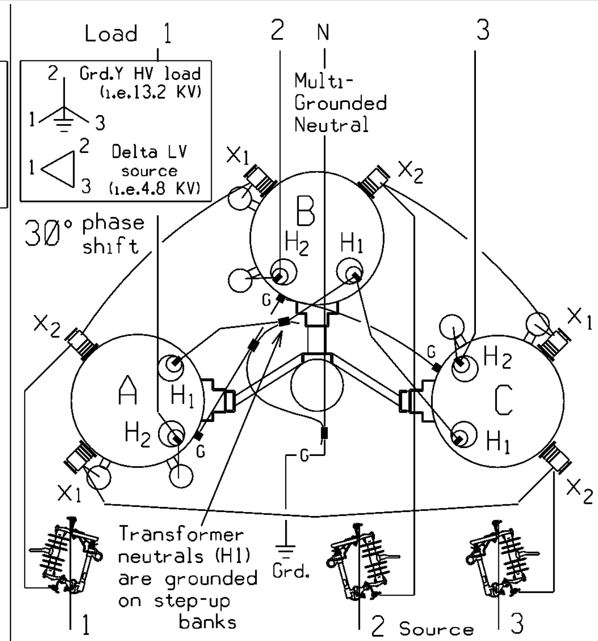
Designer	Drawing	Date
MPR	od14326	5/14/21

3Φ CONVENTIONAL DUAL VOLTAGE TRANSFORMER INSTALLATION
5 kV WYE CIRCUITS

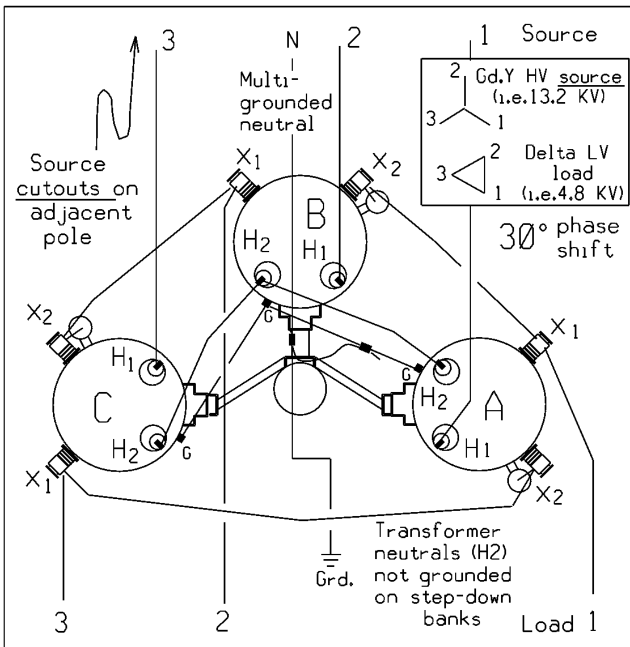
Supersedes 7/08 – Revised Figures 2 and 4 – Added ground to configuration inset drawings.



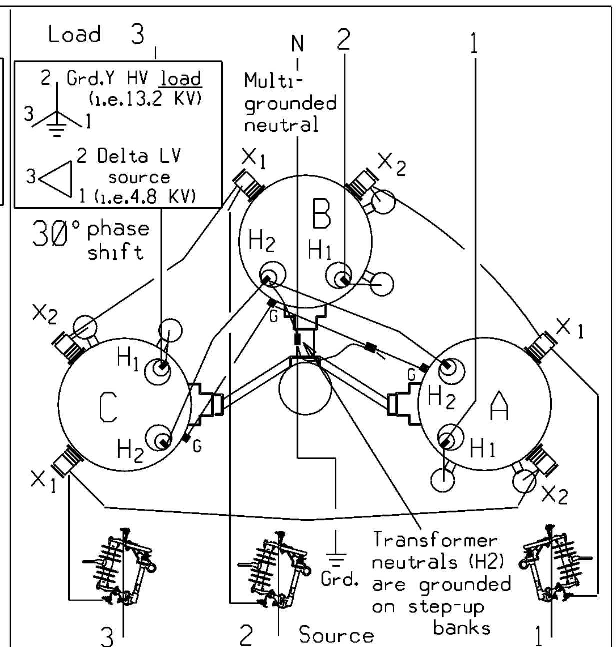
1-2-3 Phase Rotation Step Down Y- ▲ Figure 1



1-2-3 Phase Rotation Step Up ▲ -Y Figure 2

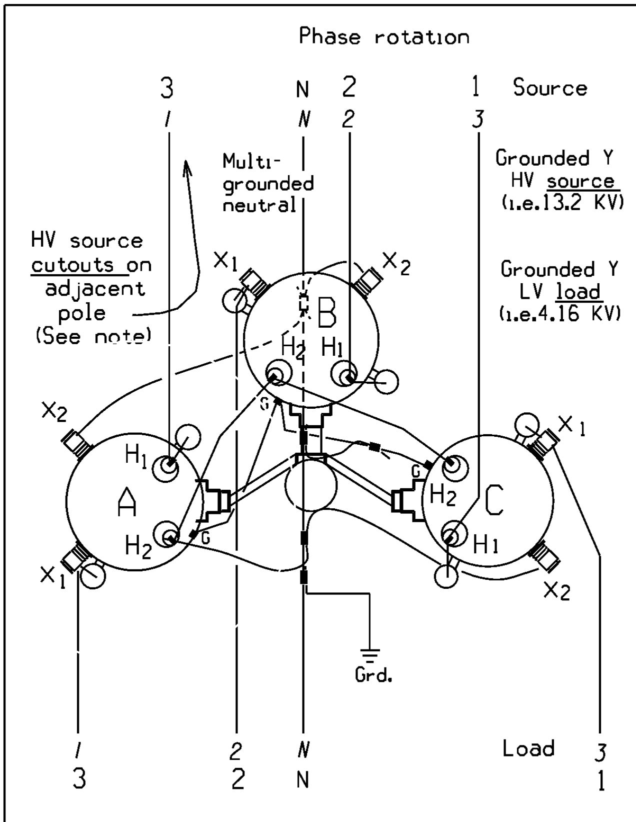


3-2-1 Phase Rotation Step Down Y- ▲ Figure 3

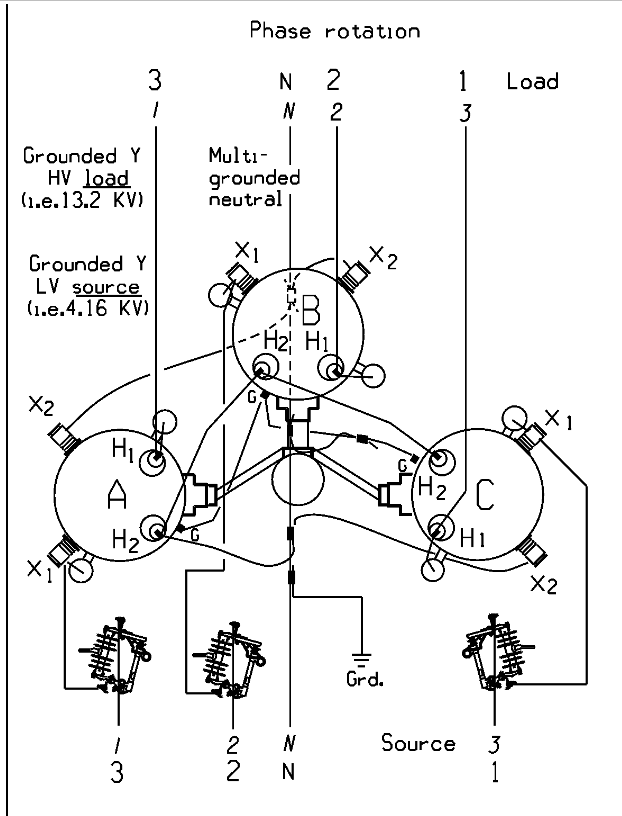


3-2-1 Phase Rotation Step Up ▲ -Y Figure 4

Note: -"American standard practice (ANSI C57.105) is to connect the H1 & X1 bushing to phase and to ground the H2 & X2 designated bushing. The H2 & X2 bushings are connected to phase in some of these wiring diagrams, however, where doing so will simplify (shorten) the secondary wiring.
Tank mounted surge arresters may require repositioning where phase bushings are switched.
Relative feeder phase positions are maintained through the bank installation.



Grounded Wye Primary Step Down Wiring
Figure 1

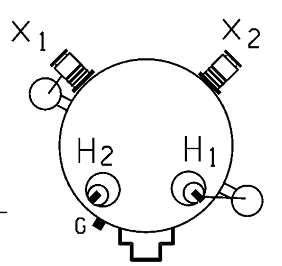


Grounded Wye Primary Step Up Wiring
Figure 2

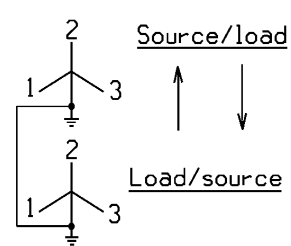
Notes:

Figures 1 and 2 are the same except for placement of the cutouts, which are always located on the source side.
Location of the transformers on the high voltage side of the pole limits available space for the source cutouts on the same pole. These shall be located on an adjacent source-side pole.
See Page 14-375 for wiring diagrams for subtractive polarity transformers (250-500KVA).

Top View

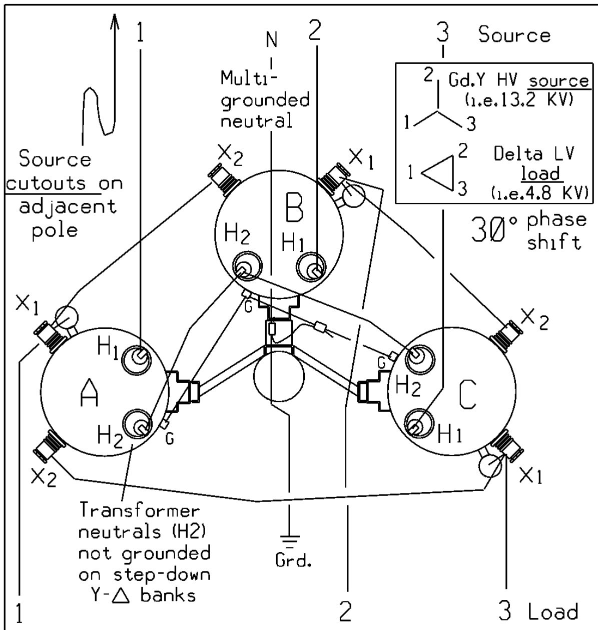


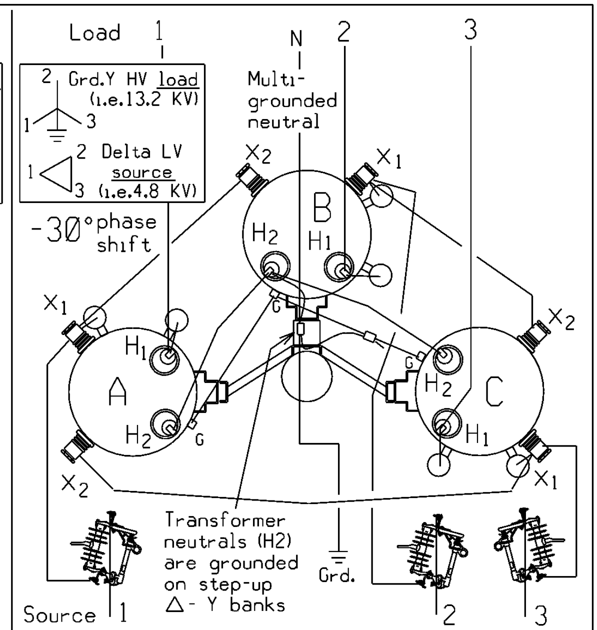
Transformers
0-200KVA
-additive polarity-



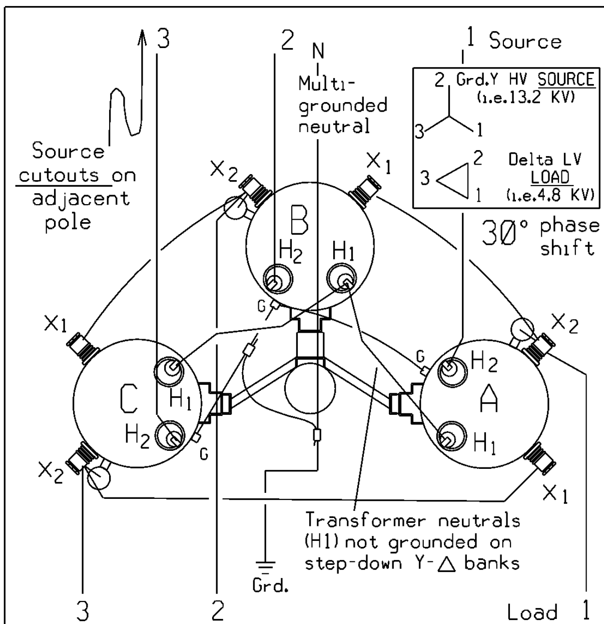
0° Standard phase shift
(angular displacement)

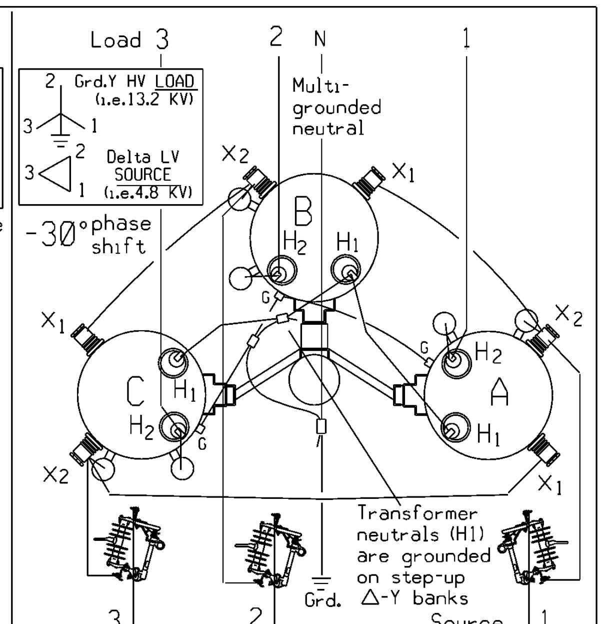
Supersedes 1/06 Issue – Corrected spelling of additive on Top View Diagram





1-2-3 Phase Rotation Step Down Y- △ Figure 1 | 1-2-3 Phase Rotation Step Up △ -Y Figure 2



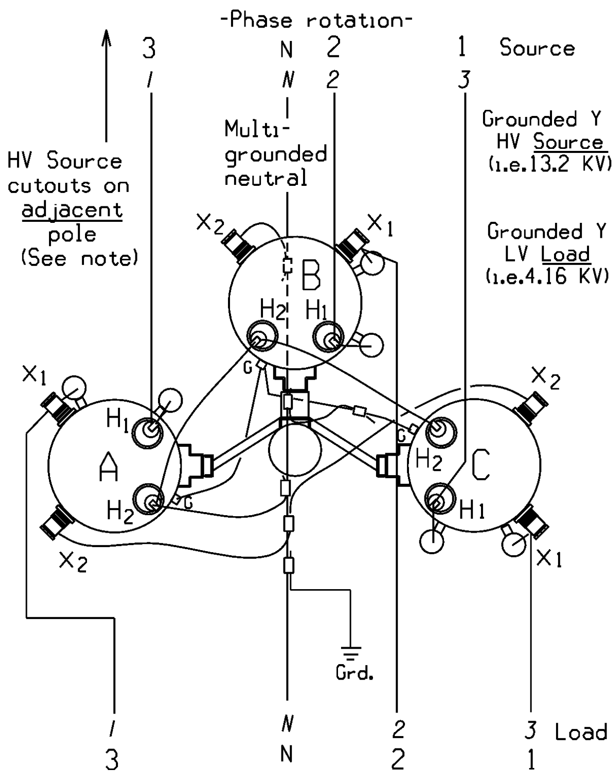


3-2-1 Phase Rotation Step Down Y- △ Figure 3 | 3-2-1 Phase Rotation Step Up △ -Y Figure 4

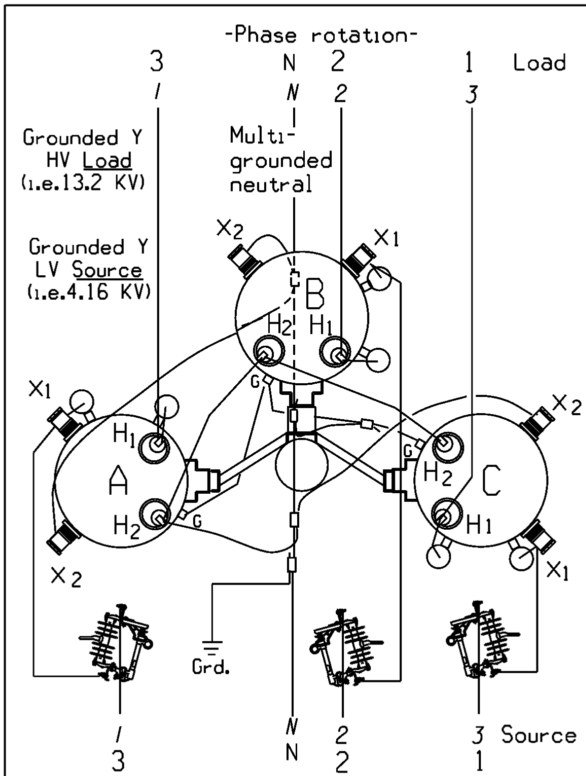
NOTE: - Standard practice (ANSI C57.105) is to connect the H.V. H1 bushing to phase and to ground the H2 designated bushing. The H2 bushing is connected to phase in some of these wiring diagrams where doing so will simplify (shorten) the secondary wiring.
- Relative feeder phase positions are maintained through the bank installation.

Supersedes 7108 Issue – Revised Figures 2 and 4 – Added ground to configuration inset drawings

3Φ STEP-UP/STEP-DOWN WIRING DIAGRAM
DELTA (LV): WYE (HV) – SUBTRACTIVE TRANSFORMERS (250 kVA)



Grounded Wye Circuits Step Down Wiring
Figure 1

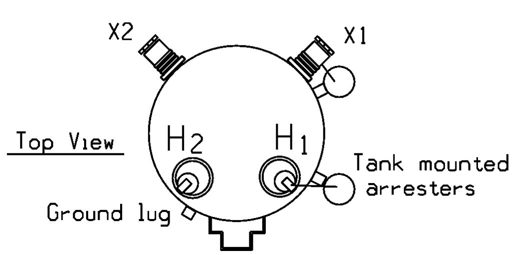


Grounded Wye Circuits Step Up Wiring
Fig. 2

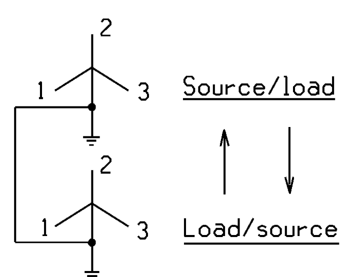
Notes:

Figures I and II are the same except for placement of the source-side cutouts.
Location of the transformers on the high voltage side of the pole limits available space for the source cutouts on the same pole. These shall be located on an adjacent source-side pole.

See Pages 14-345, 14-346 and 14-375 for subtractive polarity transformers (250-500KVA) wiring diagrams.



250KVA Transformers
-subtractive polarity-



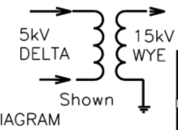
0° Standard phase shift
(Angular displacement)

Supersedes 1/06 Issue – Changed arrester position from X2 to X1 on Top View

3Φ STEP-UP/STEP-DOWN WIRING DIAGRAM WYE (LV): WYE (HV) – SUBTRACTIVE TRANSFORMERS (250 kVA)			
ISSUE	**PAGE NUMBER**	**OVERHEAD CONSTRUCTION STANDARD**	ppl
7/08	**14-346**		

MU = @(U)K(X)P(Y)S(Z)TYR	Assembly
CU = TV(W)K(X)P(Y)S(Z)TR	Transformer
***See Page 14-81 For ( ) Variables	

Supersedes 710 Issue – Revised drawing to 3-D.

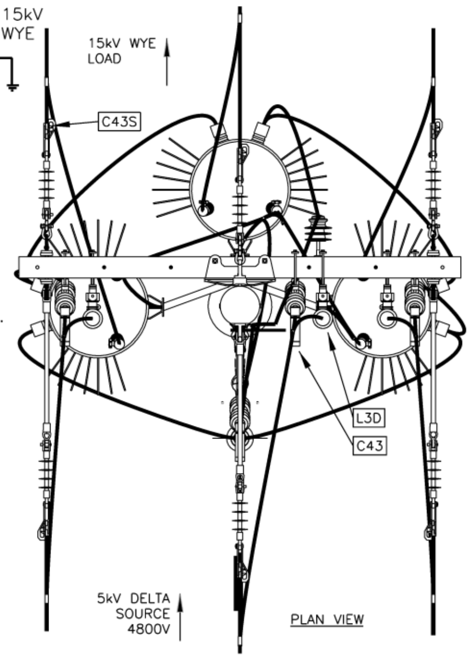


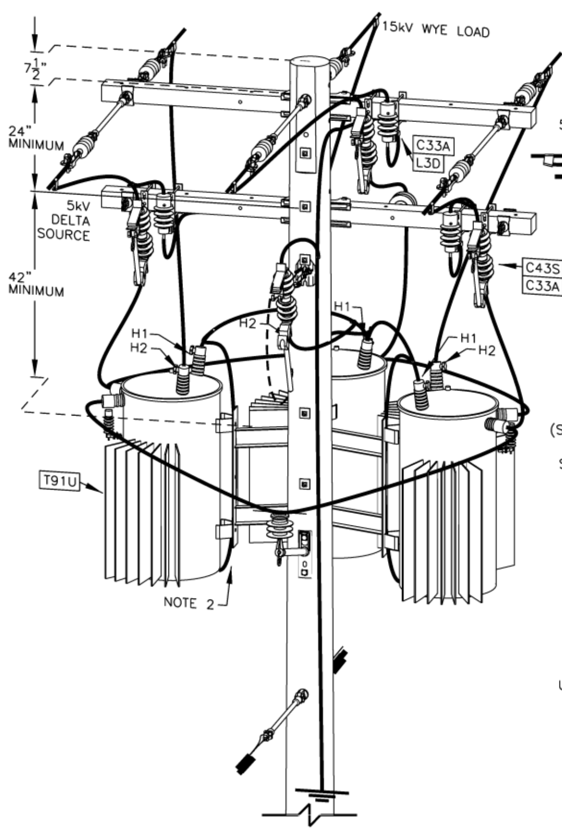
NOTES:

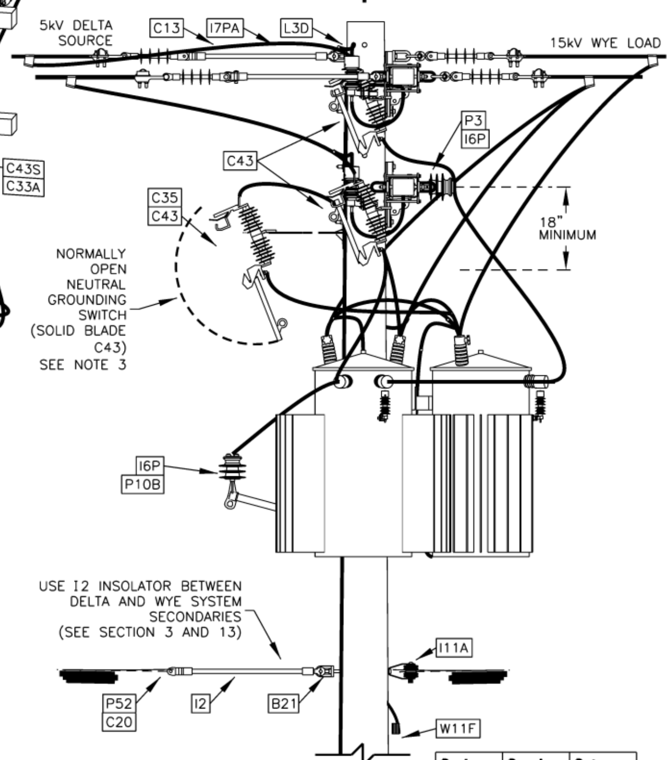
1. THIS INSTALLATION DRAWING IS BASED ON WIRING DIAGRAM FIGURE 2, PAGE 14-343 - DELTA-WYE STEP-UP USING ADDITIVE (200KVA & BELOW) TRANSFORMERS. SEE SPECIFIC WIRING DIAGRAMS (PAGES. 14-343-346) FOR THIS AND OTHER SCHEMES.

2. ALL GROUNDS MAY BE TIED TOGETHER AT PRIMARY RATIO BANKS. PRIMARY/HV WINDING NEUTRALS ARE TIED TOGETHER AND GROUNDED - EXCEPT ON WYE TO DELTA STEP-DOWN BANKS WHERE THE PRIMARY TRANSFORMER NEUTRAL "FLOATS" AND IS NOT GROUNDED (AS IN FIGURE 1 PAGE.14-343).

3. ON WYE-DELTA BANKS THAT MAY BE REVERSE-SOURCED A NEUTRAL-ISOLATING DISCONNECT SHALL BE INSTALLED -LOCATED AT THE PRIMARY LEVEL FOR CREW SAFETY. THE SOLID BLADE SHOULD BE REMOVED FROM THE SWITCH AND HUNG (STAPLED) ON THE POLE, BELOW THE SWITCH DURING NORMAL OPERATING CONDITIONS.



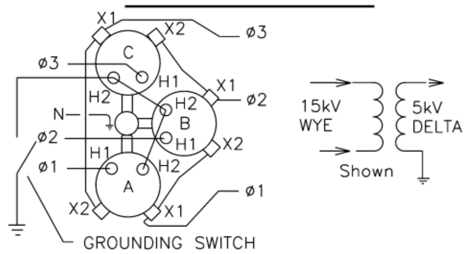


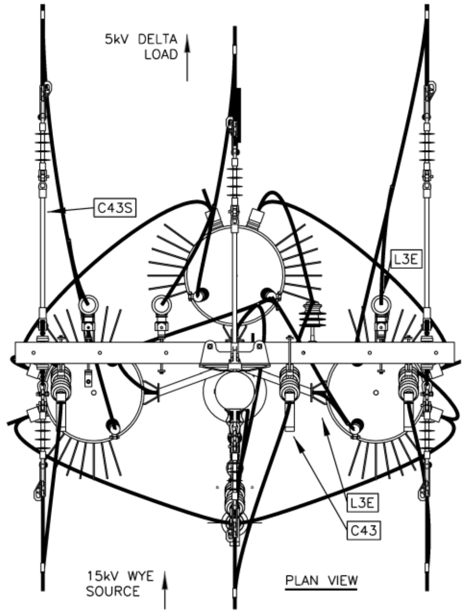


Designer	Drawing	Date
MPR	od14347	6/18/21

MU = @(U)K(X)P(Y)S(Z)TYR	Assembly
CU = TV(W)K(X)P(Y)S(Z)TR	Transformer
***See Page 14-81 For ( ) Variables	

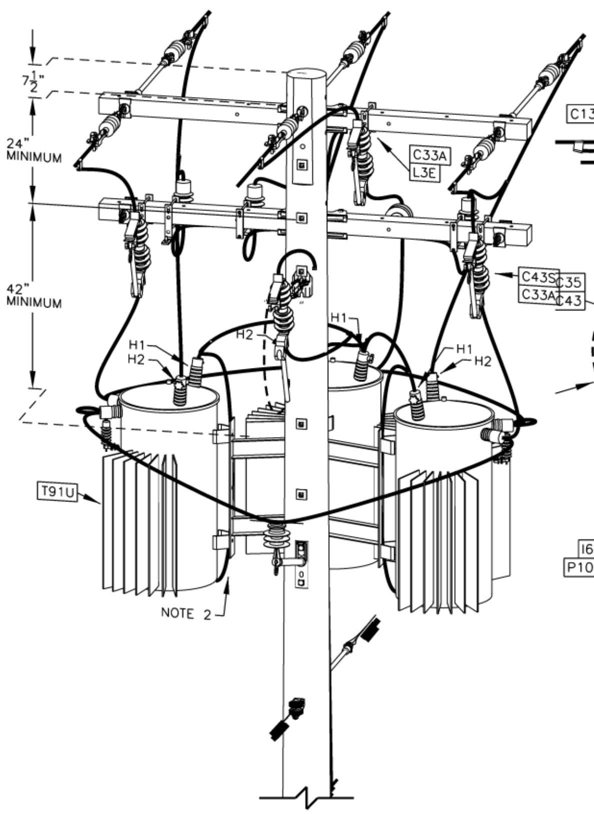
GENERAL WIRING SCHEMATIC

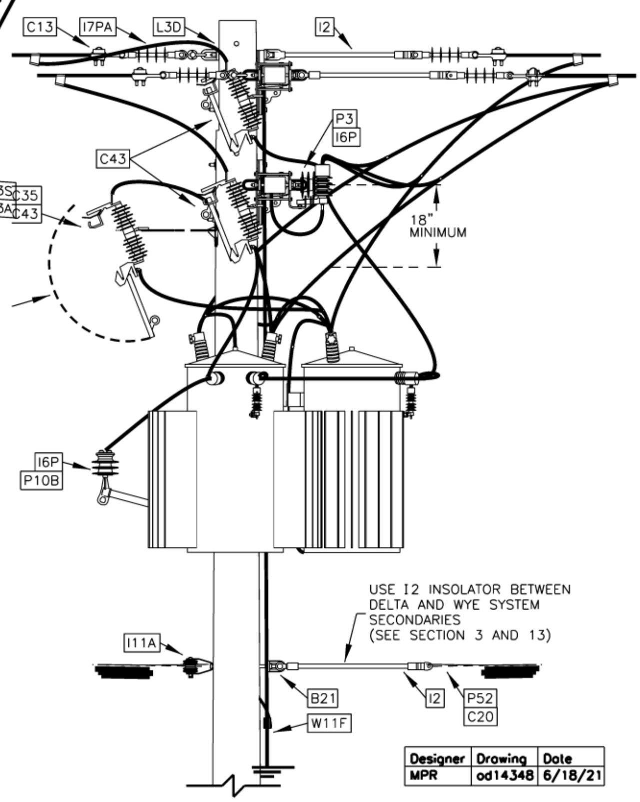




NOTES:

1. THIS INSTALLATION IS BASED ON WIRING DIAGRAM FIGURE 3 PAGE 14–343. "IF THE CONNECTION IS WYE–DELTA, THEN THE PHASE OF X1 LAGS THAT OF H1 BY 30°" (ANSI)
2. ALL GROUNDS MAY BE TIED TOGETHER AT PRIMARY RATIO BANKS. PRIMARY/HV WINDING NEUTRALS ARE TIED TOGETHER AND NOT GROUNDED.
3. SOURCE SIDE OPEN CUTOUTS MAY BE LOCATED ON ADJACENT POLE TO MINIMIZE CONGESTION.
4. THE SOLID BLADE SHOULD BE REMOVED FROM THE SWITCH AND HUNG (STAPLED) ON THE POLE, BELOW THE SWITCH DURING NORMAL OPERATING CONDITIONS.



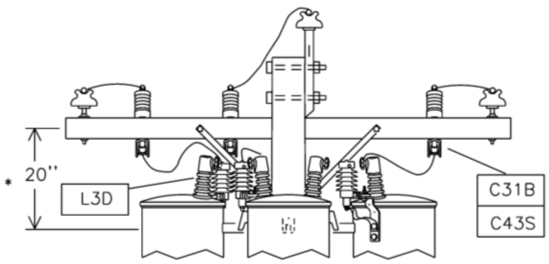


Designer	Drawing	Date
MPR	od14348	6/18/21

3Φ TRANSFORMER BANK
15 kV TO 5 kV STEP-DOWN INSTALLATION

MU = @(U)K(X)P(Y)S(Z)TD	Assembly
CU = TV(W)K(X)P(Y)S(X)TC	Transformer
CU = TMC(E)(F)VSNE	Cluster Mount
***See Page 14-81 For ( ) Variables	

Supersedes 7/16 Issue – Replaced three-phase equipment bracket with fiberglass crossarm in Figure 2.



3| Crossarm Pole Top
Figure 1

Notes:

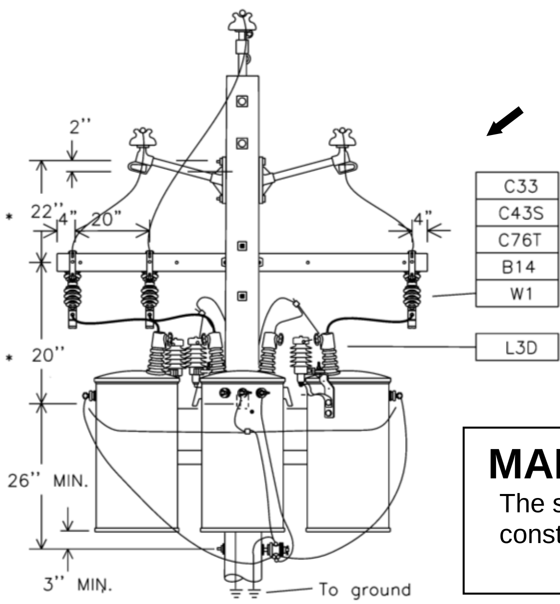
See Pages 14-131 & 132 for details and materials for mounting transformers.

See Section 5 for connectors.

See Section 9 for primary pole tops which may take less pole top space if rearranged. Alternate arrangements with slight modifications exist reusing 35' poles.

* These are nominal minimums for 0-25 kva transformers. Allow greater spacing per 15kV drawings. if conversion is likely or for transformers over 25 kva.

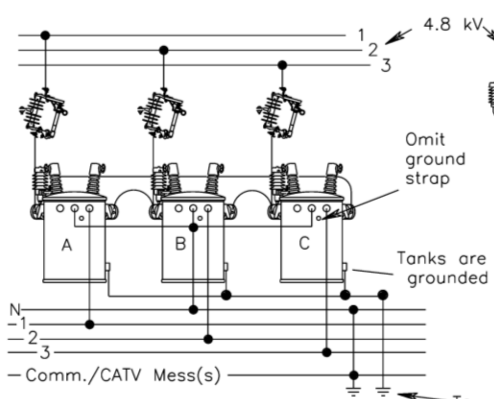
For 480 V delta services, provide a 480Y/277, 4 wire service per Figure 3.



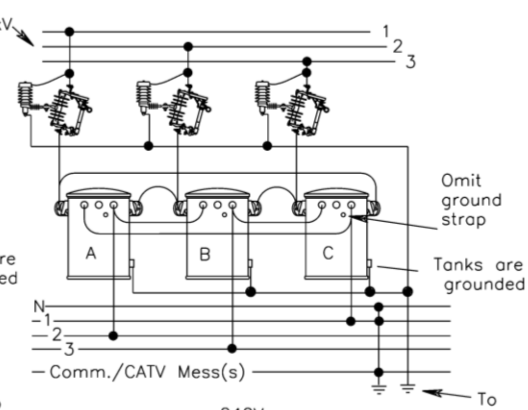
Typical Pole
3| Armless Pole Top
Figure 2

MAINTENANCE PURPOSES ONLY

The spacings shown in this drawing are not the preferred construction method. For new installations, see Standard Drawing 14-371.



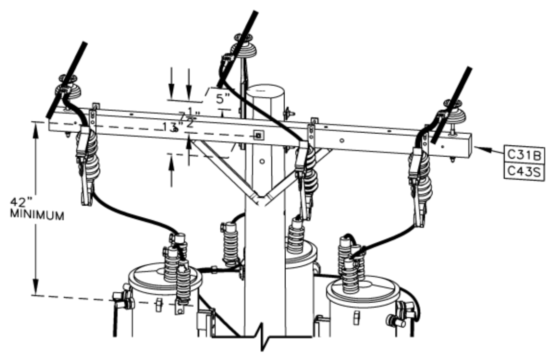
480Y/277 or 208Y/120V
Wiring Diagram Figure 3



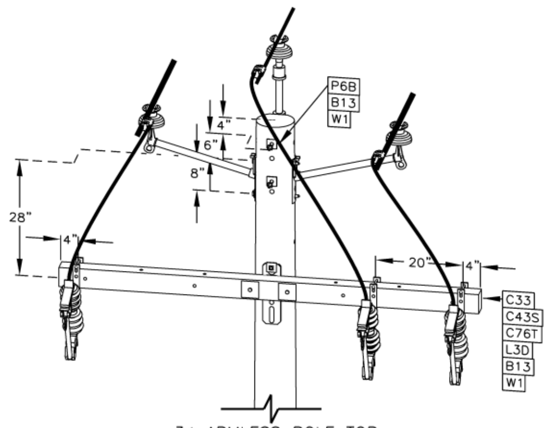
240V
Wiring Diagram Figure 4

Designer	Drawing	Date
MPR	od14352	7/19/18

MU = @(U)K(X)P(Y)S(Z)TD	Assembly
CU = TV(W)K(X)P(Y)S(Z)TC	Transformer
CU = TMC(E)(F)VNE	Cluster Mount
***See Page 14-81 For ( ) Variables	



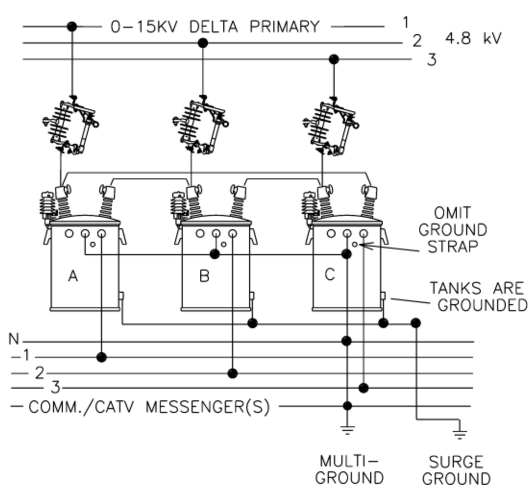
3Ø CROSSARM POLE TOP
FIGURE 1



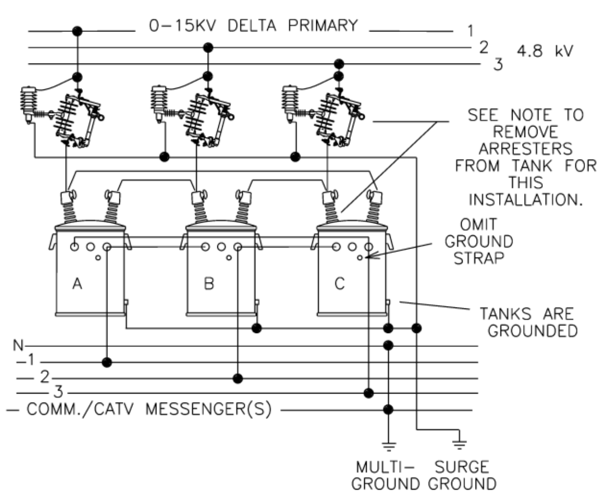
3Ø ARMLESS POLE TOP
FIGURE 2

NOTES:

1. SEE PAGE 14–173 & 176 FOR WIRING DIAGRAMS.
2. SURGE ARRESTER GROUNDS ARE NOT INTERCONNECTED WITH ANY OTHER MULTI–GROUNDS ON DELTA PRIMARY CIRCUITS.
3. FLOATING WYE–DELTA INSTALLATIONS (FIGURE 4) MUST HAVE ARRESTERS REMOVED FROM THE TANK AND RELOCATED AHEAD OF THE CUTOUT ONTO A BRACKET OR CROSSARM FOR PROTECTION OF THE ARRESTER FROM DAMAGING OVERVOLTAGES INDUCED DURING SWITCHING OPERATIONS (OPENING/RECLOSING OF ITS ASSOCIATED CUTOUT).



480Y/277 OR 208Y/120V
WIRING DIAGRAM FIGURE 3



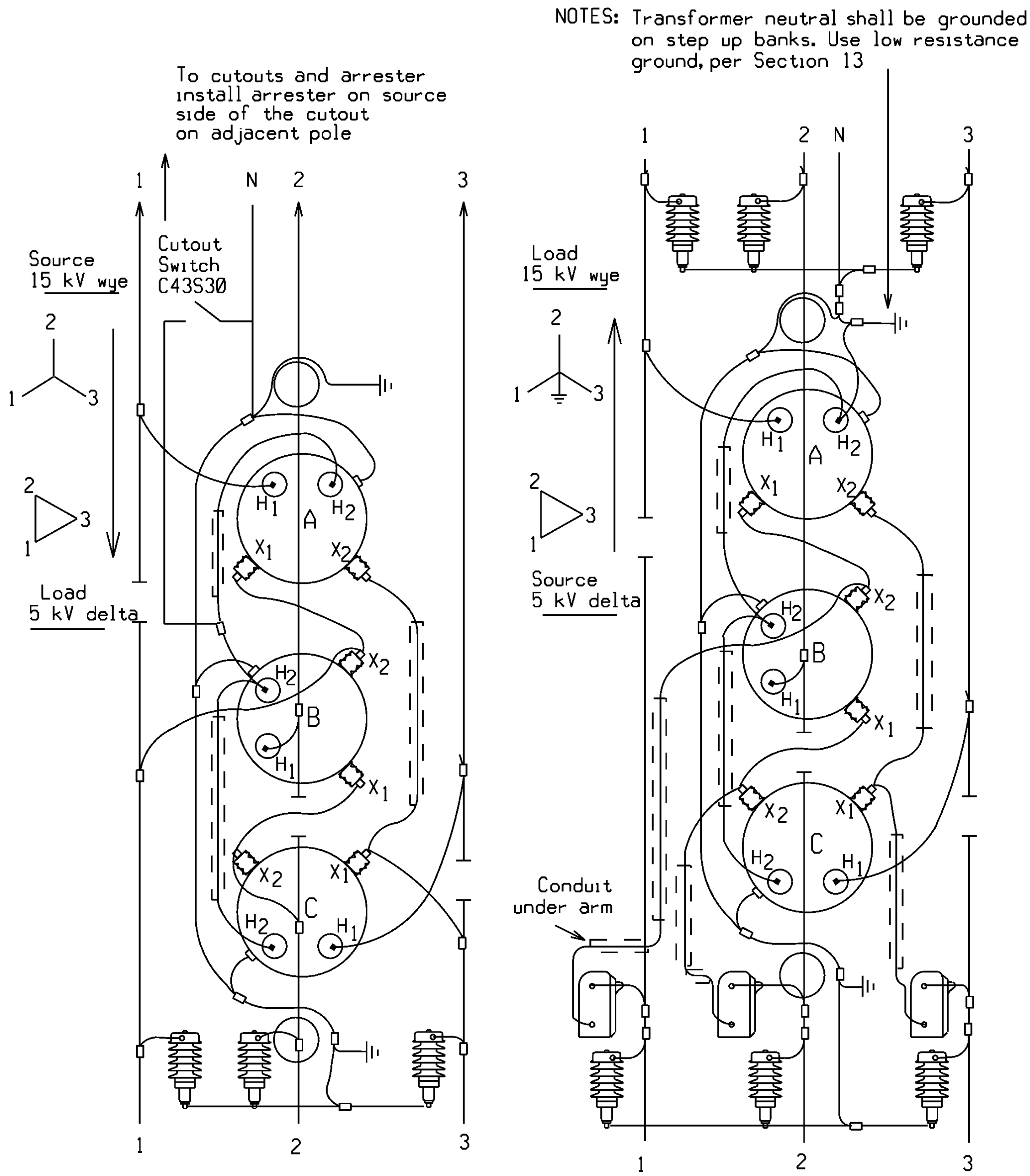
240V
WIRING DIAGRAM FIGURE 4

Designer	Drawing	Date
MPR	od14371	6/18/21

Supersedes 7/18 Issue – Revised drawing to 3-D.

3Φ CONVENTIONAL SINGLE OR DUAL VOLTAGE TRANSFORMER INSTALLATION ALL 5 – 15 kV DELTA CIRCUITS

ISSUE	PAGE NUMBER		
7/21	14-371	OVERHEAD CONSTRUCTION STANDARD	ppl



Step down 15kV wye to 5kV delta

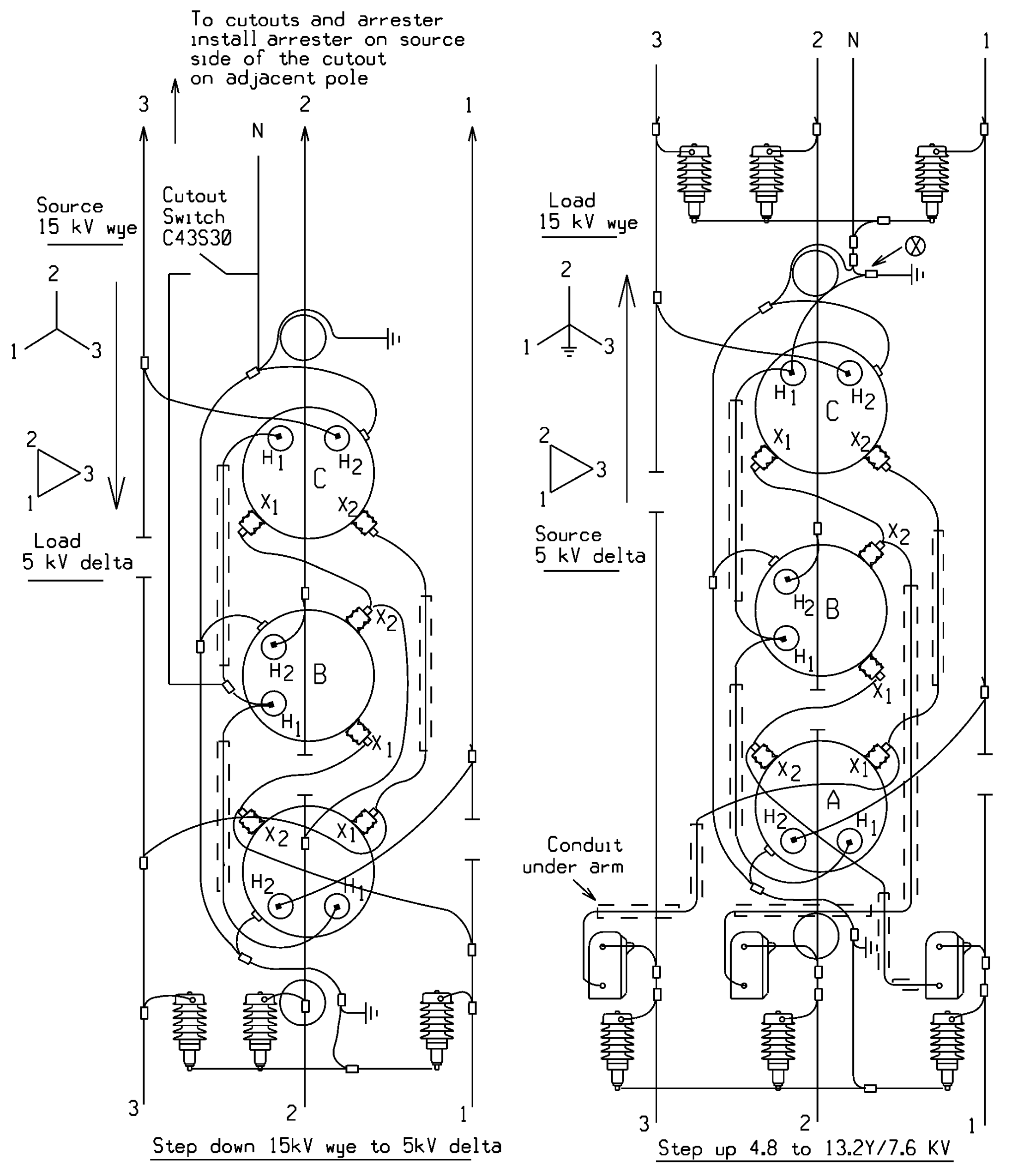
Step up 5kV delta to 15kV wye

For transformers 333 KVA & below only

Supersedes 7/09 Issue – Revised wiring of neutral cutout switch

3Φ STEP-UP/STEP-DOWN BANK (PLATFORM MOUNT)
5 – 15 kV – 333 AND 500 kVA TRANSFORMERS (SUBTRACTIVE) - 123 ROTATION

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	14-373	7/11

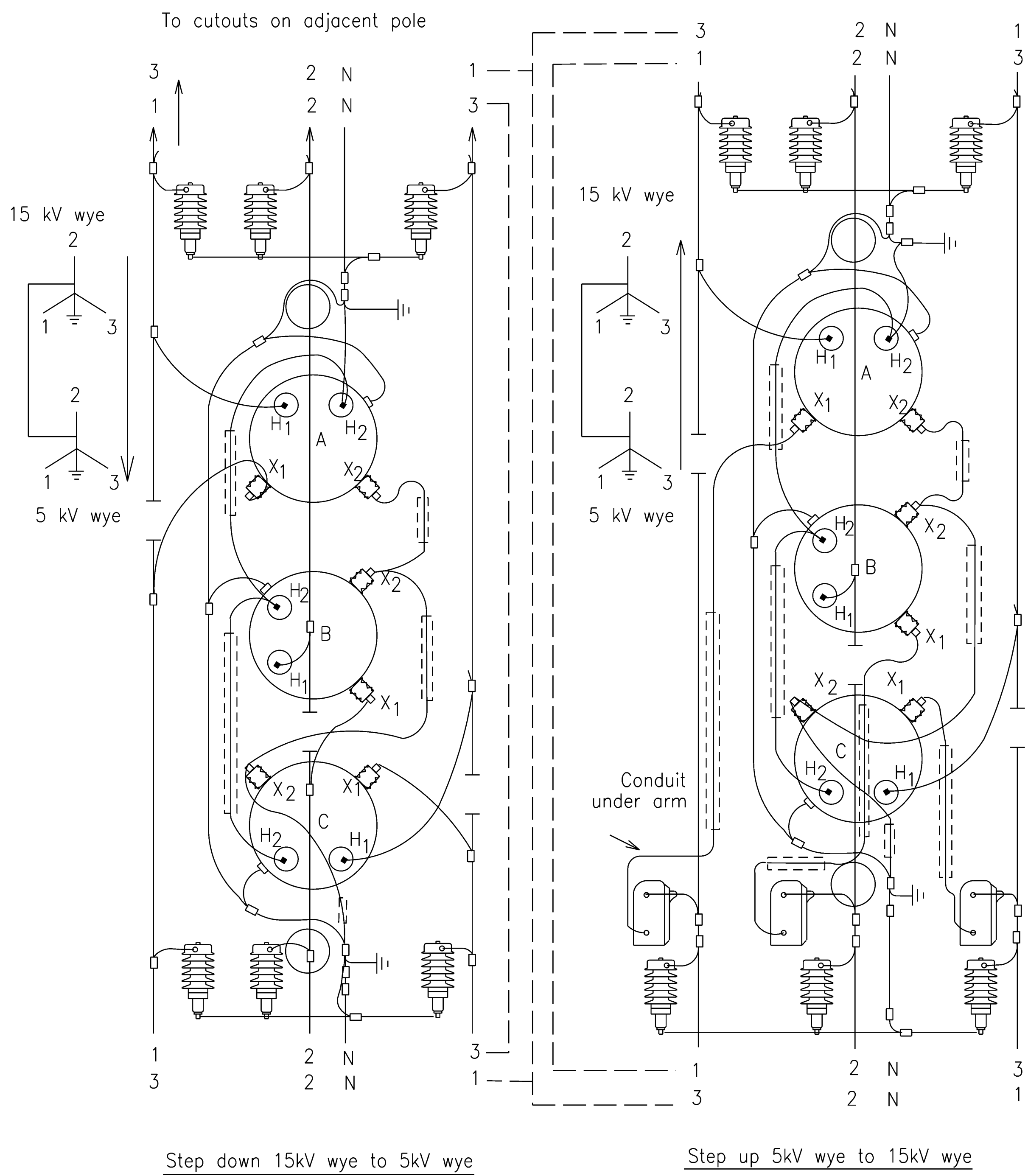


Notes:

- ⊗ Transformer neutral shall be grounded on step up banks. If this ground connection is made disconnectable on installations which may be operated bi-directionally, that cutout shall be located at the primary level. A single-phase interruption or transformer failure during a step-down condition could result in primary voltage at point of opened ground.
- Use low resistance ground see Section 13.. Illustrated Neutral is multi-grounded.
- Standard practice (ANSI C57.105) is to connect the H.V. H1 bushing to Phase and to ground the H2 designated bushing. Practical bussing considerations of the Delta L.V. conductors, however, may make other schemes preferable. Relative feeder phase positions are maintained across/through the bank installation.

Supersedes 7/09 Issue – Revised wiring of the neutral cutout switch

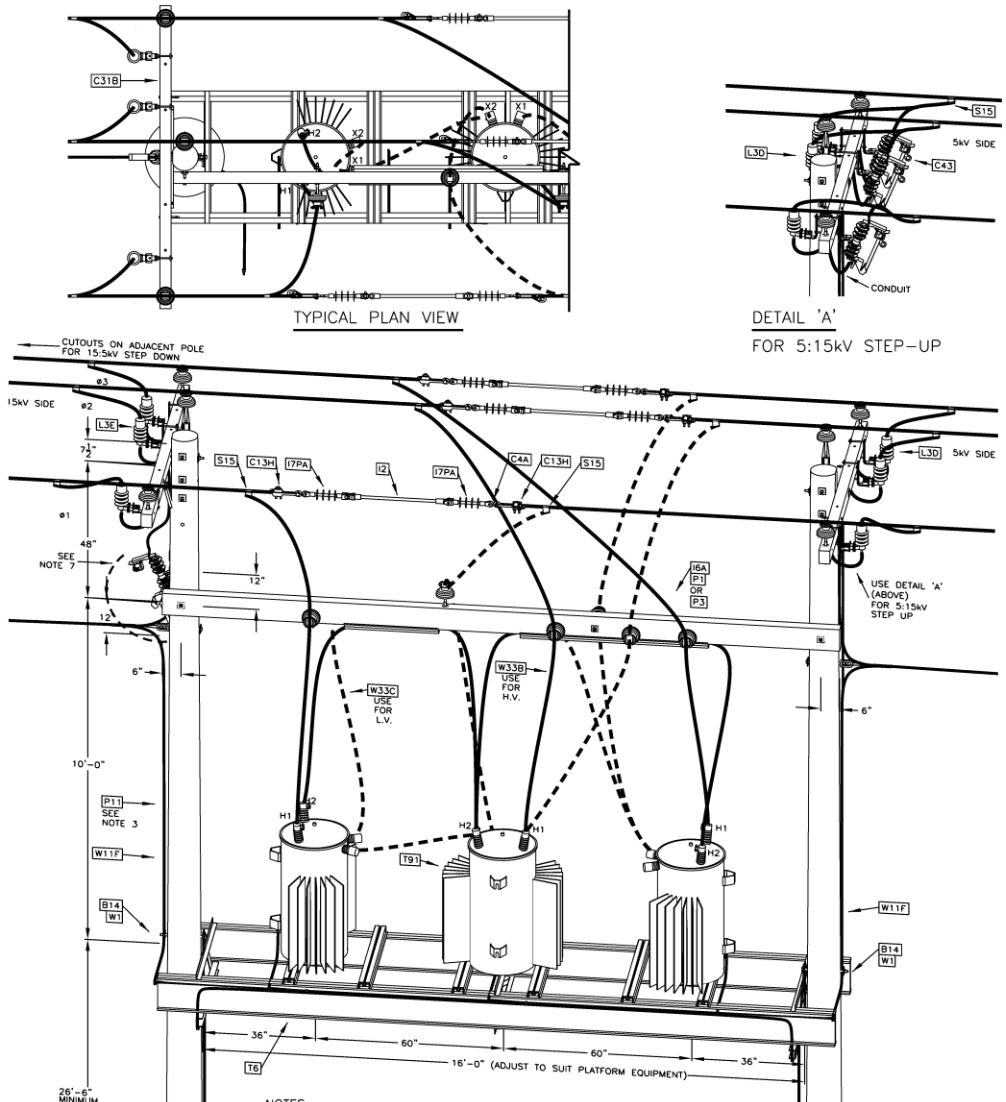
Supersedes 1/06 Issue – Corrected phasing diagram in Step down drawing.



Designer	Drawing	Date
MPR	od14375	7/15/19

5 kV WYE TO 15 kV WYE WIRING DIAGRAM – 333 AND 500 kVA TRANSFORMERS

MU = @(U)K(X)P(Y)S(Z)TYR	Assembly
CU = TV(W)K(X)P(Y)S(Z)TR	Transformer
CU = RMPT6	Cluster Mount
***See Page 14-81 For ( ) Variables	



NOTES:

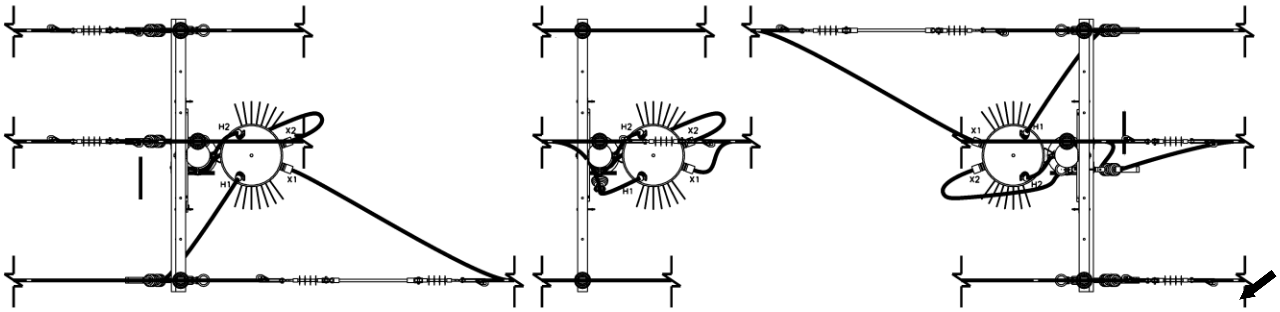
1. DO NOT USE 500 KVA TRANSFORMERS FOR STEP-UP BANKS (DUE TO COORDINATION PROBLEMS WITH STATION PROTECTION).
2. SEE PAGE 14-373 TO 14-375 FOR WIRING DIAGRAMS. USE W33C FOR L.V. WIRING AND W33B FOR H.V. WIRING.
3. USE 50' CLASS 2 POLE, TOP-CUT TO SUIT FIELD CONDITIONS, WITH A 8' POLE SETTING. DRILL 9' DEEP HOLE AND TAMP-IN (COMPACT) 12" BOTTOM GRAVEL UNDER POLE. (14-131)
4. THE PLATFORM MAY BE INSTALLED AT 17'-6" MINIMUM HEIGHT ABOVE GROUND WHERE COMMUNICATIONS FACILITIES WILL NOT SHARE USE OF THESE POLES.
5. USE TIE-DOWN CLIPS TO FASTEN TRANSFORMERS TO PLATFORM.
6. SEE PAGE 14-378 FOR 3-POLE INSTALLATION ALTERNATE.
7. GROUNDING ISOLATION SWITCH (CUTOUT) REQUIRED FOR ALL INSTALLATIONS.
8. THE LOWEST PART OF THE GROUNDED PLATFORM (SIDE RAILS, BRACES OR COMMON SUPPORT BRACKETS) SHALL BE AT LEAST 40" ABOVE ANY VERIZON OWNED WIRE OR CABLE AND AT LEAST 30" ABOVE ANY OTHER COMMUNICATION WIRE OR CABLE.

Designer	Drawing	Date
MPR	od14377	6/18/21

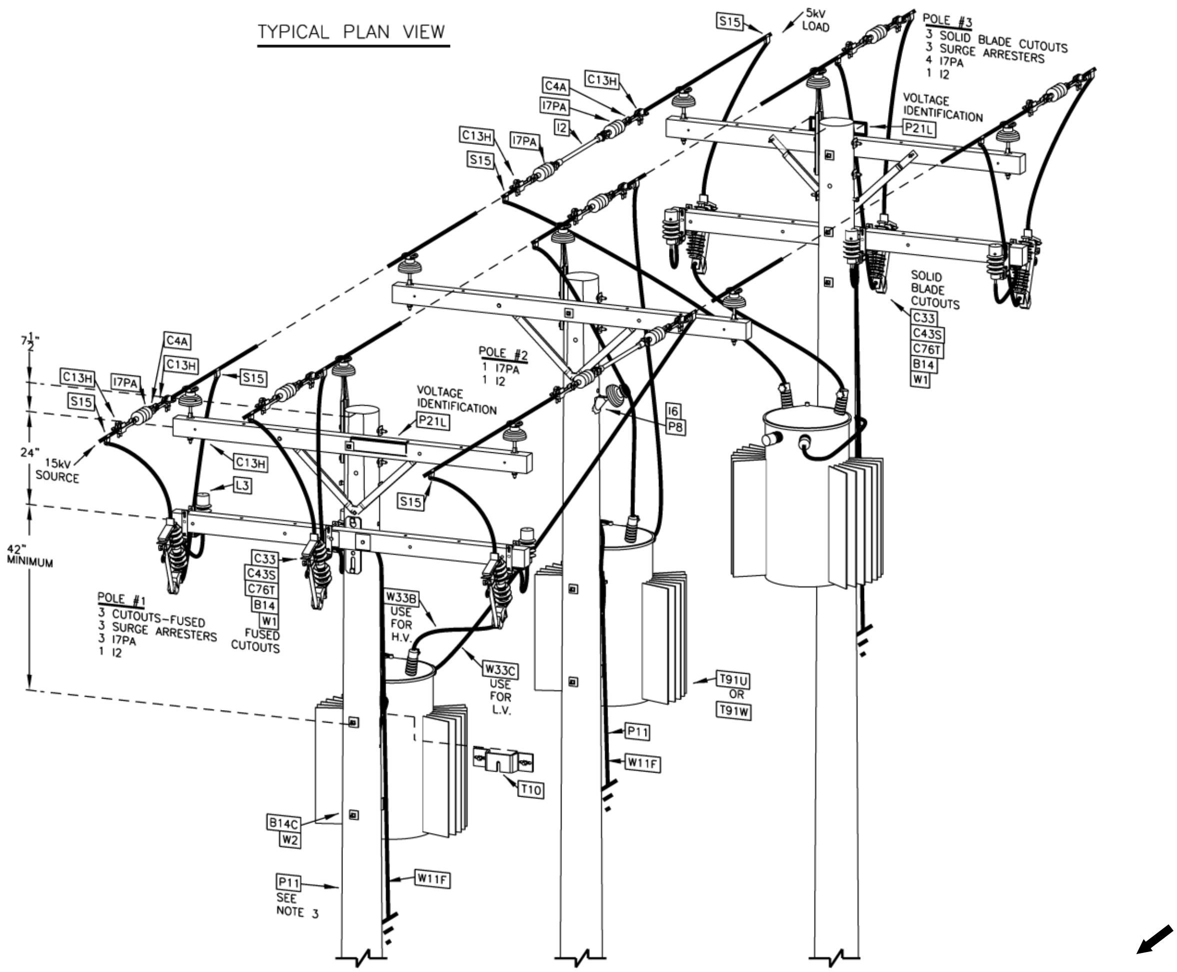
Supersedes 7/19 Issue – Revised drawing to 3-D.

3Φ STEP-UP/STEP-DOWN TRANFORMER BANK INSTALLATION 333 AND 500 kVA PLATFORM MOUNTED – 15:5 kV AND 5:15 kV – WYE-DELTA

Supersedes 7/18 Issue – Update to 3D Drawings



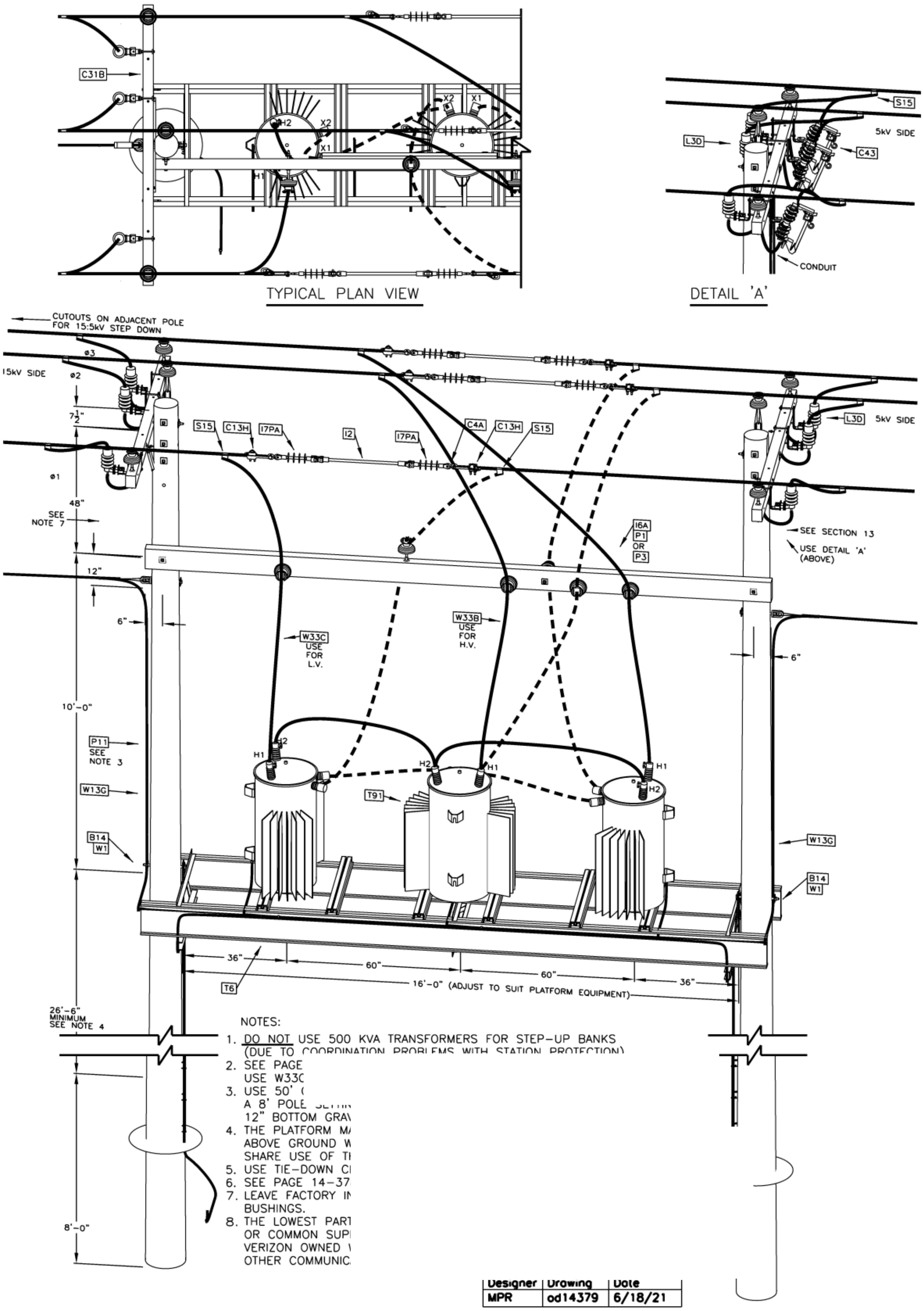
TYPICAL PLAN VIEW



NOTES:

1. COST AND APPEARANCE CONSIDERATIONS MAY PRECLUDE USE OF STANDARD (14-377) PLATFORM ARRANGEMENT.
2. THIS DRAWING SHOWS 1500KVA Y-Y, ZERO PHASE-SHIFT, TRANSFORMATION. DO NOT USE 500KVA TRANSFORMERS FOR STEP-UP BANKS (DUE TO COORDINATION PROBLEMS WITH STATION PROTECTION).
3. STANDARD NEW OR SOUND EXISTING POLES SHALL BE USED FOR THIS ARRANGEMENT. POLES IN THIS ARRANGEMENT SHALL NOT BE USED FOR OTHER EQUIPMENT SUCH AS A SECONDARY TRANSFORMER FOR EXAMPLE. POLES SHALL BE CONSECUTIVE AND IN-LINE AND PREFERABLY IN-VIEW OF EACH OTHER. DO NOT INSTALL MID-SPAN POLES AND AVOID HEAVY DOWN GUYS.
4. POLE/CROSSARM SHALL BE CLEARLY MARKED WITH PRIMARY VOLTAGE INDICATION AS REQUIRED FOR SAFETY.

Designer	Drawing	Date
MPR	od14378	5/14/21



Supersedes 7/19 Issue – Revised drawing to 3-D.

3Φ STEP-UP/STEP-DOWN TRANFORMER BANK INSTALLATION
333 AND 500 kVA PLATFORM MOUNTED – 15:5 kV AND 5:15 kV – WYE-WYE

ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/21	14-379		

Version	Date	Modification	Author(s)	Approval by (Name/Title)
14	07/21	• Revised drawings to 3-D format: 14-121, 14-131, 14-132, 14-204, 14-121, 14-131, 14-132, 14-204, 14-212, 14-247, 14-248, 14-249, 14-250, 14-252, 14-263, 14-264, 14-271, 14-304, 14-305, 14-312, 14-326, 14-347, 14-348, 14-371, 14-377, and 14-379. • Corrected section reference in headers on pages 14-121 through 14-NOTES-2. • Add item 11 under 14.7.30A on page 14-5.		
13	07/20	• Added new secondary codes 56 and 86 to physical data code tables on page 14-54. • Added new Type Code 42 on page 14-50. • Corrected footers of 14-50 to 14-81.		
12	07/19	• Corrected phasing diagram for step-down transformer on page 14-375. • Added note on pages 14-377 and 14-379 to provide clearance requirements to communication wires and cables.		
11	07/18	• Replaced three-phase equipment brackets with fiberglass crossarms in drawings 14-304, 14-312, 14-326, 14-352, 14-371, and 14-378.		
10	07/17	• Corrected pole spacing for item T6 on page 14-132 • Updated drawings and notes on 14-377 and 14-379.		
9	07/16	• Revised 14-379 to correct neutral connection wire size.		
8	07/15	• Revised 14.5 by eliminating requirement to replace all three CSP transformers in a bank when replacing one. • Revised 14.7.30, paragraphs 4 and 5 to match EOP D006 requirements for grounding cutout. • 14-343 & 14-345 – Added ground to configuration inset drawings in Figures 2 and 4. • 14-348 – Corrected connections in lower left view. • 14-377 – Modified for Wye-Delta. • 14-379 – Added new drawing for Wye-Wye.		
7	07/14	• Corrected low side arrester locations on 14-348.		
6	07/13	• Minor text edits for 14-5, 14-8, 14-51 and 14-53 • Corrected std item ID for 14-377		
5	07/12	• Corrected date on page 14-204. • Revised minimum spacing for transformer installations on pages 14-204, 14-304 and 14-305.		

Version	Date	Modification	Author(s)	Approval by (Name/Title)
4	07/11	• Corrected page reference on Page 14-1 • Wording revisions on Pages 14-4 and 14-5 • Corrected Std Item # on Page 14-171 • Added washer on page 14-211 • Added washer and changed crossarm mounting dimension on pages 15-212, 15-331, 15-332, 15-333, 15-334. • Corrected incorrect neutral switch wiring on Pages 14-373 and 14-374.		
3	07/10	• Revised 500kcmil Std Item # • Revised PDC Tables on page 14-54. • Moved arrester note from top of page to Diagram 7 on page 14-176. • Removed note on arrester locations on page 14-177. • Added 4W 480Y/277 to 3-167KVA drawing • Removed ground strap on page 14-252 • Removed note limiting transformer size to 167kVA on pages 14-247, 248, 249 and 250 • Revised page title on page 14-301 • Revised tank lettering on figure 1 and phaser diagrams on figures 3 & 4 on page 14-345 • Corrected error in Notes on Page 14-347. • Removed secondary ground straps on Page 14-352 and 14-371. • Corrected Std Item # on Page 14-377. • Removed “ratio” from sections of the text (correct term is “step-up/step-down”).		
2	07/09	• Corrected spelling in title on page 14-131 • Revised conductor size in table on page 14-171 • Revised grounding on Figure 1 & 5 • Replaced Figure 1 with correct drawing and revised notes on page 14-312 • Revised notes on page 14-326 • Revised Figure 1, 2 & 3 on drawing 14-352. Relocated arresters to transformers revised last note. • Revised Figure 3 on drawing 14-371. Placed arresters on transformers and deleted note “Do not connect grd. strap” in Figure 3 • Removed source side arresters, added cutout/arrester note and added neutral switch to drawing on page 14-373 • Removed source arresters, added cutout/arrester note to drawing on page 14-374 • Removed source side arresters, added cutout/arrester note to drawing on page 14-377 • Updated CUs and MUs on pages 14-248, 14-249, 14-304, 14-312, 14-326, 14-352, 14-371		

Supersedes 7/20 Issue – Update to drawings, 15.4, 15.5, 15.6

Supersedes 7/17Issue –Updated drawings

Supersedes 1/09 Issue – Shifted 15.3 to next page.

15.0 GENERAL

This Section covers the details of installing and connecting distribution voltage regulators, capacitors and primary metering. Step voltage regulators and fixed or switched capacitors are installed on primary distribution feeders to maintain and improve power factor and/or voltage regulation.

15.0.10 New Purchases – Re-use

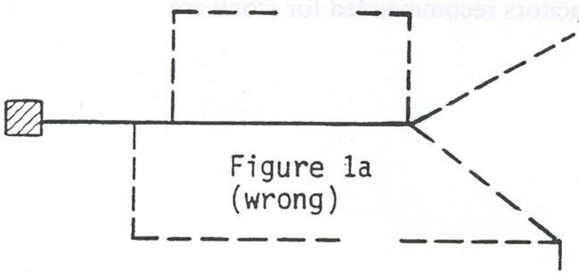
Distribution regulators and capacitors will be purchased in accordance with Company material specifications MS2821, MS2851, MS2852, and MS2853.

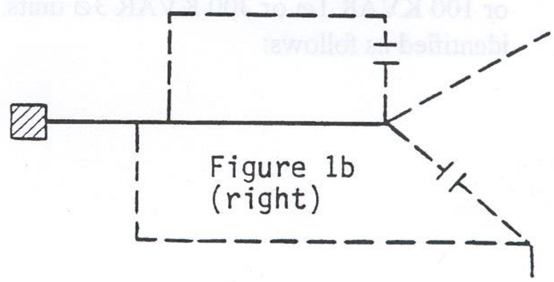
15.1 VOLTAGE CONTROL

Voltage control on distribution feeders shall be maintained through a combination of feeder design, application of capacitors, and the use of regulators.

15.1.10 Feeder Design

Feeder design should consider anticipated loads and future substation sites. Judicial selection of multiple feeder routes can reduce feeder losses as illustrated in Figure 1a and 1b below.





Note: Assuming uniformly distributed loads and constant conductor size.

15.2 VOLTAGE CORRECTION

Normal acceptable voltage at the customer service point is outlined in Section 9-Primary.

If voltage correction is necessary, proper feeder balancing shall first occur which will improve the voltage profile and in many cases resolve voltage complaints. In some cases, feeder balancing may eliminate the need for existing line regulators and/or capacitors. If the feeder is relatively balanced, station settings may need to be re-adjusted and/or additional line regulators and/or capacitors may need to be installed.

15.3 CAPACITORS

15.3.10 Distribution Capacitor Application

Capacitors are required on the distribution system to correct voltage drop, improve power factor, reduce losses, and increase system capacity. The capacitor needs of distribution feeders should be evaluated, along with conductor requirements, fusing, etc., whenever a feeder study is made by the Engineering or Planning Department.

A power engineering analysis simulation program should be used to determine the total requirements and location of capacitors. Capacitors should be installed in appropriate locations and sizes to minimize overall losses and investment cost. Proper attention must be given to both peak and light load voltage for excursions outside the allowable voltage limits. Switched banks of capacitors shall not cause a step-voltage rise of more than 3%
Switched capacitor banks in some applications are available with an advance control (Std. Item C39A). This requires the use of voltage/current sensors as shown in drawings 15-335 and 15-336. The advanced control will allow features such as voltage, current and power factor; see MS2855 for all of the controls features.

A power engineering analysis simulation program should be used to determine the available short circuit current with consideration being given to ties to adjacent feeders that may increase the available short circuit current.

The actual locating and sizing of capacitor banks on feeders is detailed in the Feeder Management Guidelines. Control settings are discussed in the application guide section of the Feeder Management Guidelines. Refer to Distribution Asset Management document DAM-007, “Reactive Compensation for Distribution Systems”. Refer to Table 1 for standard assembled capacitor banks.

15.3.20 Capacitor Installation Details

The mechanical details of installing capacitors in single or three-phase applications are shown on pages 15-211 thru 15-409.

Fuse cutouts, all styles of capacitors shall use cutouts for protection of the device. In areas where the fault current is over 5,000 amps symmetrical (4000 for 50Kvar units and smaller), current limiting fuses are required as well. See Section 12-Protection for selection of recommended fuse size for capacitor groupings.

Lightning protection shall be provided on capacitor installations by using surge arresters suitable for the respective capacitor voltage class. See Section 13-Grounding for surge arrester selection guide, as well as MS 2852 Table II.

Vacuum switches: Switched capacitor banks may come with vacuum switches supplied from ABB in place of Thomas & Betts. The control needs to be in “Motor Op” mode for the ABB vacuum switches to operate.

Supersedes 7/18 Issue – Update to 15.3.20

Supersedes 7/18 Issue – Updated table.

Table 1

Individual Capacitor Units								
System Voltage	**Bank kVAR**	**Fixed**	**Switched**	**Advanced Switched**	**Quantity**	**Size**	**No. of Bushings**	**Rack Size**
2400 Volt Delta	150 300	X X	X X	- -	3 3	50 100	2 2	3 Unit 3 Unit
2400/4160 Volt Grd Y	150 300 450	X X X	X X X	X X x	3 3 3	50 100 150	2 2 2	3 Unit 3 Unit 3 Unit
4800 Volt Delta	150 300 450	X X X	X X ‘X	- - -	3 3 3	50 100 150	2 2 2	3 unit 3 Unit 3 Unit
4800/8320 Volt Grd Y	150 300 450 600	X - X x	- X X X	- - - -	3 3 3 3	50 100 150 200	2 2 2 2	3 Unit 3 Unit 3 Unit 3 Unit
6640/11500 Volt Grd Y	600 900 1200	- - -	- - -	X X X	3 3 6	200 300 200	2 2 2	6 Unit 6 Unit 6 Unit
7200/12470 Volt Grd Y	300 600 900 1200	- X X -	- X X X	- X X X	3 3 3 6	100 200 300 200	2 2 2 2	3 unit 6 Unit 6 Unit 6 Unit
7620/13200 Volt Grd Y	300 600 900 1200	- X X -	x X X X	X X X X	3 3 3 6	100 200 300 200	2 2 2 2	3 unit 6 Unit 6 Unit 6 Unit
7960/13800 Volt Grd Y	300 600 900 1200	- X X -	- X X X	X X X -	3 3 3 6	100 200 300 200	2 2 2 2	3 unit 6 Unit 6 Unit 6 Unit
13800 Volt Delta	1200	-	X	-	6	200	2	6 Unit
13280/23000 Grd Y	1200	-	X	-	6	200	2	9 Unit
23000 Volt Delta	1800 2700	-	X X	- -	6 9	300 300	2 2	6 unit 9 Unit
19920/34500 Grd Y	1200 1800	- -	X X	X X	6 9	200 200	1 1	6 Unit 9 Unit

15.4 REGULATORS

15.4.10 Voltage Regulator Application

Where primary voltage levels cannot be controlled within acceptable limits by capacitors and station regulation, pole mounted feeder regulation is required. The data sources available to perform a review include RAP reports, feeder V/O monthly readings, feeder modeling studies and portable recording voltmeters.

Step type voltage regulators raise or lower the incoming primary voltage by 10% and the regulator tap changers divide the 10% raise or lower voltage into 16 individual steps. Each step on a regulator adds ⅝% of the maximum raise or lower voltage to the primary circuit.

The range of regulation can also be limited and the regulator's normal current rating will increase as follows.

Table 2

REGULATION RANGE % RAISE AND LOWER	NORMAL RATING % NAMEPLATE AMPERES	CURRENT RATING 76.2 KVA @ 7620V	CURRENT RATING 167KVA @ 7620V	CURRENT RATING 333KVA @ 7620V
10	100	100A	219A	437A
8.75	110	110A	241A	482A
7.5	120	120A	263A	526A
6.25	135	135A	295A	592A
5	160	160A	350A	668A

Supersedes 7/20 Issue – Text correction

15.4.20 Voltage Regulator Construction Details

Single and 3 phase regulator construction details are shown on Pages 15-111 thru 15-156. The primary connections and grounding details are shown on the installation drawings.

The preferred 3 phase regulator method of installation on effectively grounded circuits is to install each regulator onto a separate pole eliminating unnecessary congestion and allowing for a quicker replacement and re-energization during a contingency condition (e.g. motor vehicle accident).

Single phase regulator installations, depending upon operating preference on effectively grounded circuits, shall be in accordance with Pages 15-112 and 15-113.

The preferred 3 phase regulator method of installation on not effectively grounded circuits (e.g. delta), is to use either three regulators or two regulators. If using two regulators resulting in an open delta connection, the location shall be relatively balanced and the high and low inductive voltage phases shall be determined through a preliminary load/voltage monitoring check and be the phases regulated.

Should there be more than one point of regulation on a single radial 3-phase line, the phases being regulated should be alternated. For example, if the first point of regulation is connected between phases 1-2 and 2-3, then the second point should be connected between phases 2-3 and 3-1, and the third point should be connected between phases 3-1 and 1-3.

Where practical, aluminum platform installations should be oriented with dial indicators and disconnect switches on the road side. Where this is not practical, the dial indicators and disconnect switches should be readily accessible by bucket truck. In this case, consideration to the terrain, slope and accessibility of the area behind the regulator installation.

15.4.30 Voltage Regulator Sizing and Schematic

These are the basic steps in determining the size and connection type of the voltage regulator for utility applications:

1. Determine the system configuration (i.e. 3-phase, 4-wire multi-grounded wye or 3-phase, 3-wire delta). This will be the basis for the automatic voltage regulator (AVR) connection type.
2. Establish the amount of voltage regulation needed (e.g. ±5%, ±10%)
3. Determine the system phase voltage on which the AVRs will be connected. Remember that the phase voltage is affected by the system configuration (1).
4. Calculate the maximum load current of the feeder or line.
5. Multiply the percent voltage regulation (2), system phase voltage (3) and maximum line current (4) to get the required kVA size of the automatic voltage regulator.

For example, compute for the step-voltage regulator size needed by a 3-phase, 4-wire multi-grounded feeder with a system voltage of 13800Y/7970 V. The required voltage regulation is 10% and the peak connected load is 6.0 MVA.

1. System Configuration is 3-phase, 4-wire, multi-grounded wye - means that the voltage regulators shall be connected grounded wye.
2. Voltage regulation = 10%
3. Phase voltage is the line-to-neutral voltage = 7.97 kV (since it is a 4-wire multi-grounded wye feeder)
4. $\text{Load Current} = \dfrac{6.0\ \text{MVA}}{1.732 \times 13.8\ \text{kV}} = 251\ \text{A}$
5. $\text{Voltage Regulator kVA Size} = 10 \times 7.97\ \text{kV} \times 251\ \text{A} = 200\ \text{kVA}$

Use three 32-step voltage regulators, each with a standard rating of 333 kVA, 7970 V, ±10% regulation.

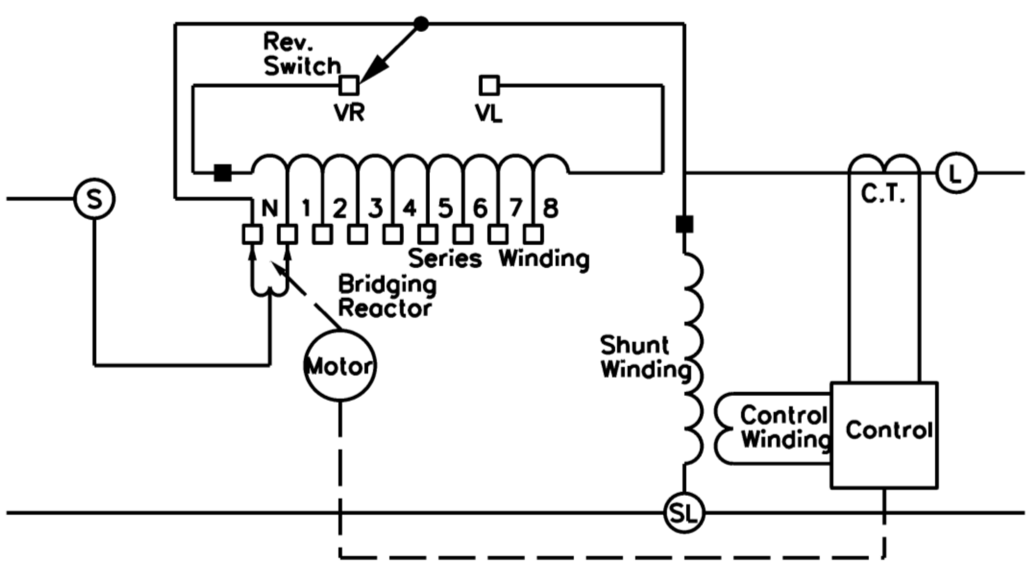


Figure 2
Voltage Regulator Wiring Schematic

Supersedes 7/20 Issue – Text shift.

15.4.40 Voltage Regulator Bypass Switch

1. The voltage regulator bypass switch provides a three step switch sequence with one operation of the switch. The switch helps reduce the Worker's time spent in the primary space during switching events.

2. Bypass switches shall be numbered/labeled per drawing requirements

Note: A voltage regulator should never be energized or bypassed while stepped off the neutral position. Doing so can cause dangerous circulating currents to develop causing catastrophic equipment failure. Refer to the appropriate Electric Operating Procedures for voltage regulator operations.

15.5 PRIMARY METERING

This section specifies pole-top primary metering installations using outdoor-type instrument transformers mounted on a pre-fabricated aluminum bracket. For pad-mounted primary metering devices to be used with UG cables, please refer to Section 38 in the UG Construction Standards book.

For installations in the legacy Niagara Mohawk territory, please refer to Electric System Bulletin (ESB) 753.

All Customer-furnished devices shall be approved by the Company and be placed on a Company-approved pole or structure. The Customer shall submit their plans and specifications to the Company before equipment is ordered or before construction has started to ensure that the proposed design for the electric service installation conforms to the Company's requirements.

15.5.10 Primary Metering Accompanied by a Riser

A primary metering device and a riser may be placed on the same pole if the loadbreak device is on an adjacent pole when a loadbreak switch is used as a disconnect point. See the drawings on Pages 15-501 or Page 15-502 for details regarding primary metering and a riser on the same pole.

15.6 POLE MOUNTED AND LINE MOUNTED POWER SENSORS

Applying power sensors on the distribution system supports many key applications that drive benefits, including improved reliability, improved energy efficiency, reduced maintenance costs, improved power quality, and increased operational awareness.

Power Sensors can deliver near revenue grade current and voltage measurement to support a number of applications to improve distribution system reliability and efficiency. In some cases, sensor measurements directly drive analysis and control applications. Power sensors are also fundamental to distribution network state estimation by providing active feedback, which is becoming a prerequisite for smart grid functionality. Sensors have advanced capabilities to capture fault current and harmonics.

15.6.10 Line Post Power Sensor

Line post sensors are approved for use in pole mounted power sensing applications. These sensors must be grounded prior to energization and remain grounded while in service.

15.6.10.1 3 Phase Pole Mounted Feeder Monitor

This monitoring system requires the installation of current and voltage combination line post sensors. The sensors are wired to an advanced control which can be integrated via DNP3 to other utility back-

Supersedes 7/19 Issue – added 15.4.40 and 15.6.10. Text update in section 15.6.1

end systems such as SCADA, data historians, and energy management systems (EMS). See drawing 15-600 for installation details.

15.6.20 Line Mounted Power Sensor

15.6.20.1 Clamp-on style Power Sensor

These sensors are self-powered devices that are directly mounted to phase conductors of distribution lines via hot sticks and communicate back to the pole mounted collector control via an RF link. The sensor uses Rogowski coil technology to measure the current and a capacitive voltage sensor that eliminates the need for a neutral connection to measure the voltage. The sensors can operate continuously on line currents as low as 5 amps and up to 600 amps maximum. The collector control can be integrated via DNP3 to other utility back-end systems such as SCADA, data historians, and energy management systems (EMS). See drawing 15-650 for installation details. The collector can hold up to 30 days of local data. Distribution Control & Integration can be contacted to determine the required communication platform for the proposed installation. All installations must be calibrated with a Check (Calibration) tool before putting into service.

15.6.20.2 Installation Requirements

A. Ensure Power sensors are at least 10 feet from the nearest power pole.

B. Ensure no insulation is present on the conductors, the sensors require direct electrical contact.

C. Ensure no foreign objects (trucks, buckets, hot-sticks, etc.) are within 10 feet of the Power sensors during calibration.

D. Record serial numbers of each Power Sensor before installation and record the collector control serial number as well. This information is required for configuration of the system after installation is complete.

E. Mount the sensors with the arrow and antenna facing the direction of the load, also indicated by direction of arrow on body of sensor.

F. Take care to ensure that the arrow and antenna on the automated setup tool points in the direction of the load.

G. The check (calibration) tool +should be 10 feet from the sensor on the opposite side of the pole during calibration.

H. Recalibration may be required if additional circuits are added or the configuration on the pole changes.

I. Power Sensors must be installed within a 50' radius of the collector control.

J. Up to 6 Power Sensors can communicate back to each Collector Box.

K. Min/Max conductor size #2 – 477kcmil

Voltages 2.4kV to 19.9kV Phase to neutral

Supersedes 7/19 Issue – text shift

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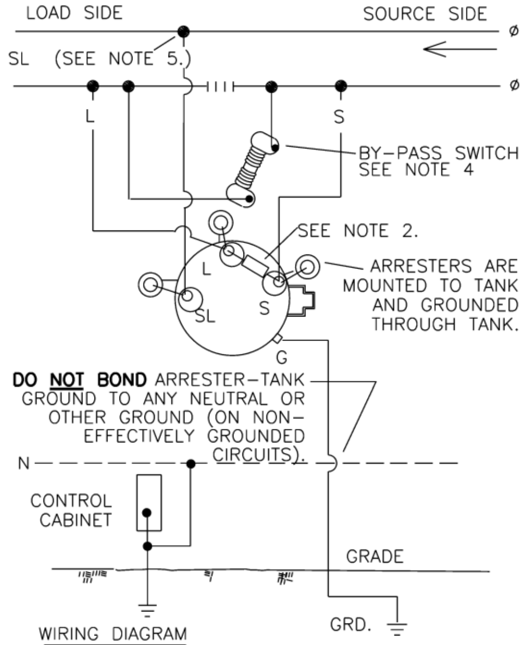
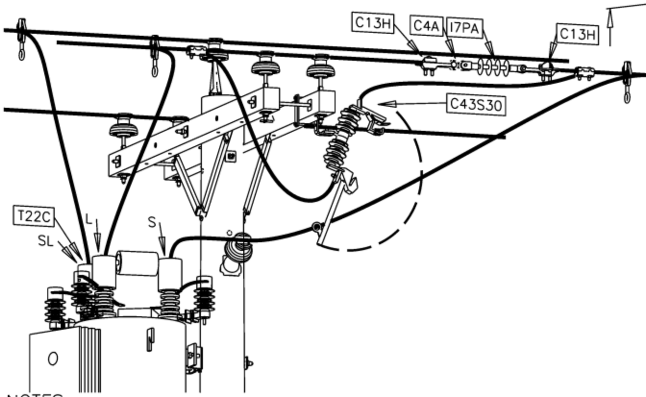
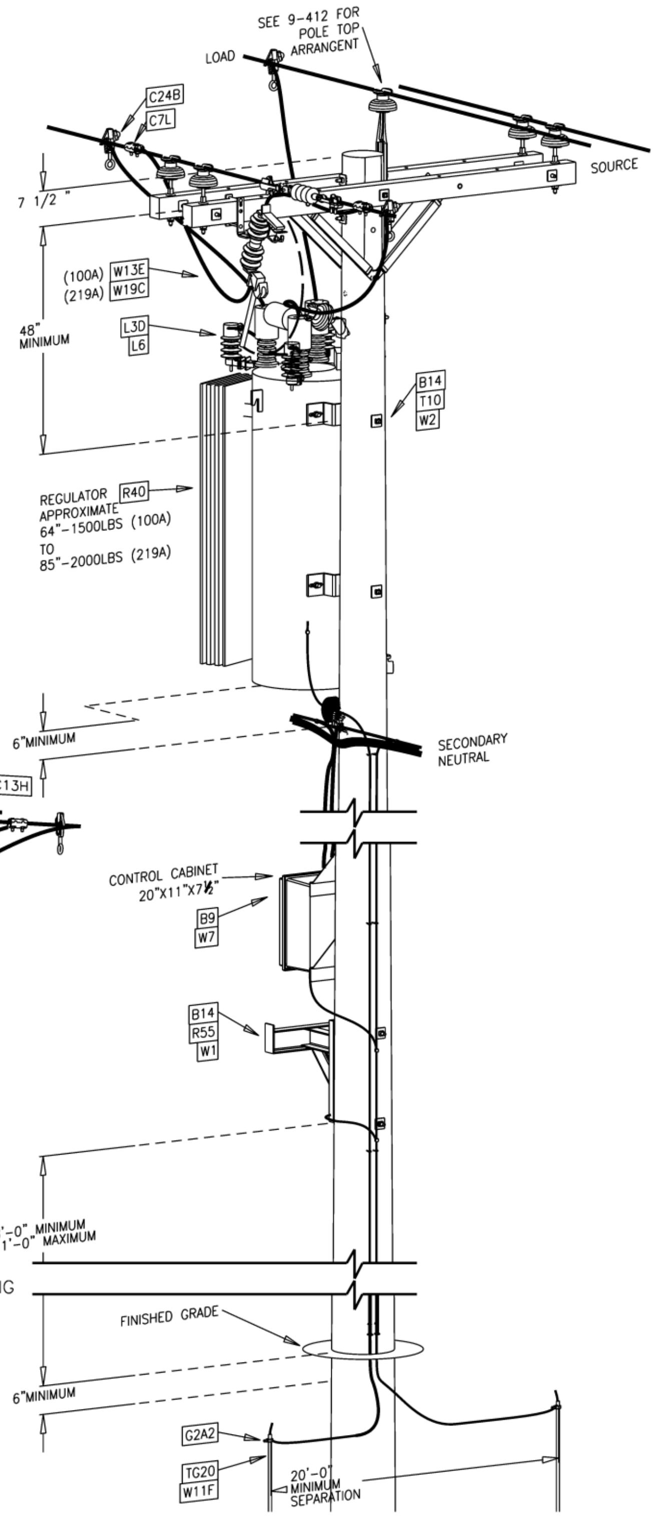
MU = @(C)KR590D	Single Regulator, (C) =(76)=76.2kVA or (167)=167kVA @4.16kV
MU = @(C)KR590D48	Single Regulator, (C) =(76)=76.2kVA or (167)=167kVA @4.8kV







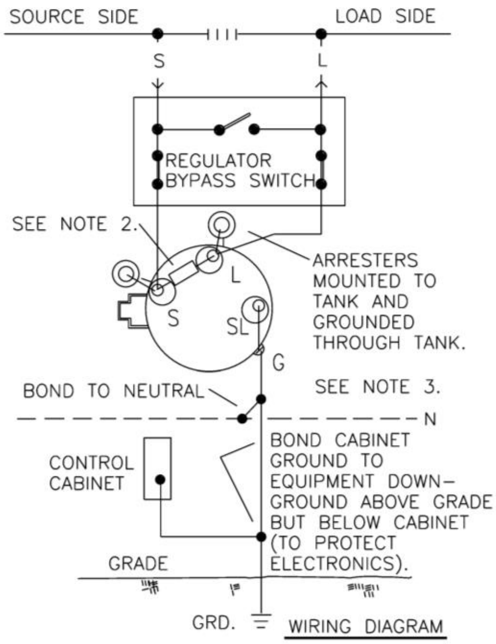
NOTES:
1. WHERE PRACTICAL THE PREFERRED INSTALLATION LOCATION IS AWAY FROM VEHICULAR TRAFFIC.
2. EXTERNAL SERIES OR BY-PASS ARRESTER(S), IF PRESENT, SHOULD NOT BE DISCONNECTED.
3. REFER TO PAGES 13-111 AND 13-113 FOR GROUNDING DETAILS.
4. DO NOT CLOSE BY-PASS SWITCH WITH LOAD CURRENT FLOWING THROUGH THE REGULATOR UNLESS REGULATOR IS IN THE NEUTRAL POSITION.
5. REGULATOR SL (COMMON) TERMINAL MUST BE CONNECTED TO THE PRIMARY WHEN CONNECTING OR DISCONNECTING S (SOURCE) OR L (LOAD) TAPS TO THE PRIMARY (FOR THE SAFETY OF PERSONNEL AND EQUIPMENT).
6. SEE SECTION 25 FOR TELECOM REQUIREMENTS.
7. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELLED PER SECTION 2.1.30

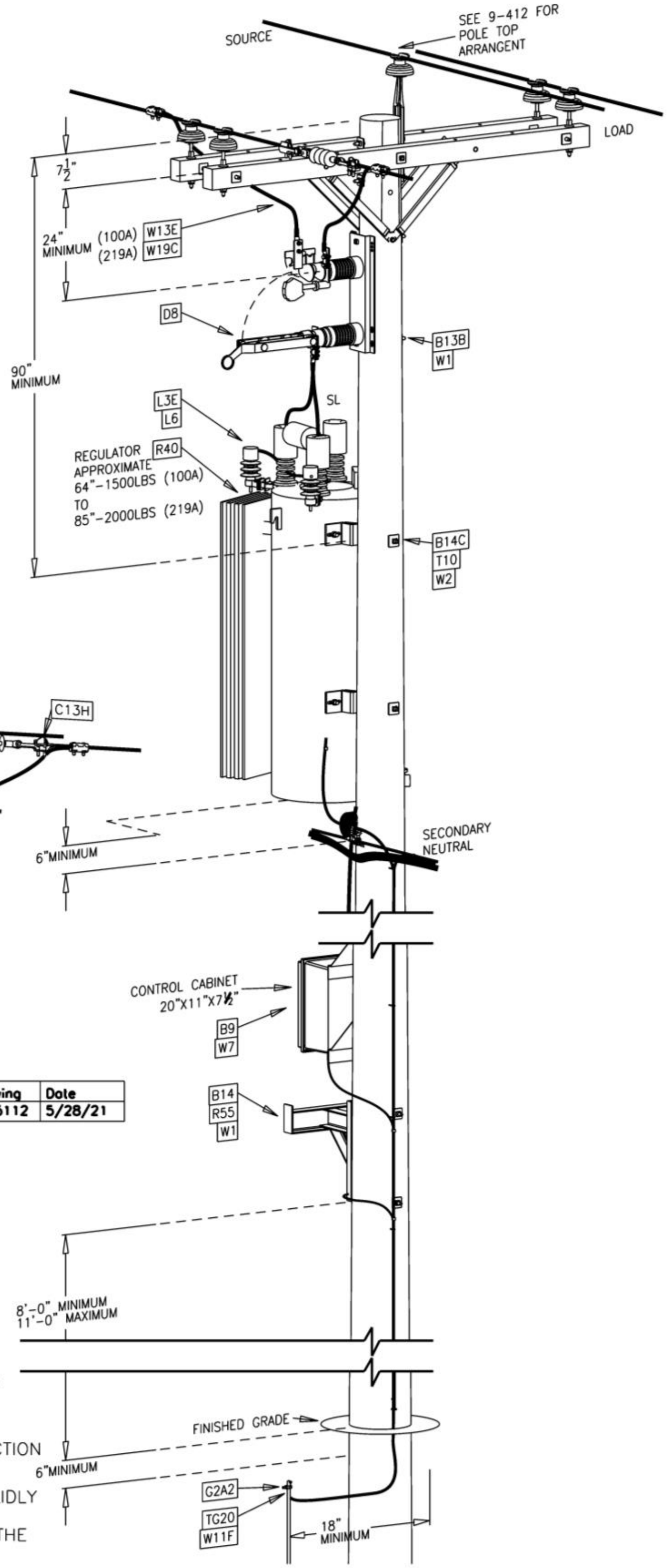
Designer	Drawing	Date
MPR	od15111	5/28/21

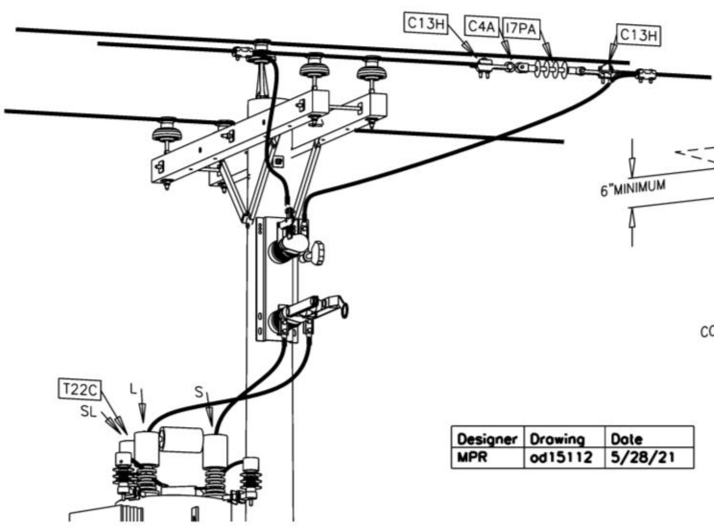
Supersedes 7/20 Issue – Update drawing to 3D

1Ø REGULATOR INSTALLATION – NOT EFFECTIVELY GROUNDED, 15kV

MU = @333KR590W(V)	333kVA; (V) =(76)=7.62kV or (796)=7.97kV







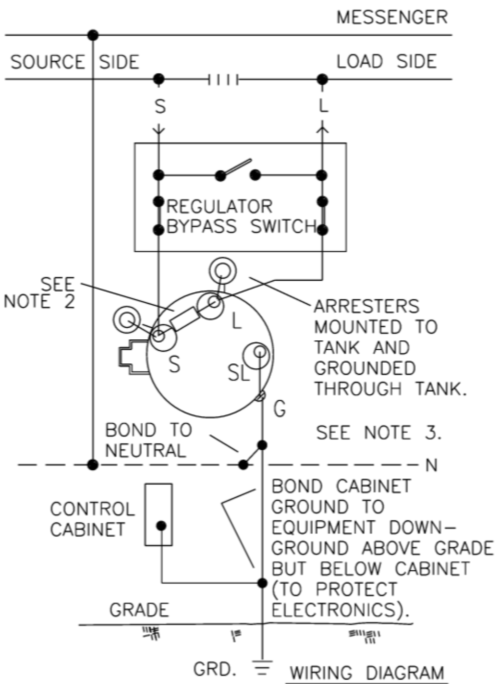
Designer	Drawing	Date
MPR	od15112	5/28/21

NOTES:

1. WHERE PRACTICAL THE PREFERRED INSTALLATION LOCATION IS AWAY FROM VEHICULAR TRAFFIC.
2. EXTERNAL SERIES OR BY-PASS ARRESTER(S), IF PRESENT, SHOULD NOT BE DISCONNECTED.
3. REFER TO PAGES 13-111 AND 13-113 FOR GROUNDING DETAILS.
4. DO NOT CLOSE BY-PASS SWITCH WITH LOAD CURRENT FLOWING THROUGH THE REGULATOR UNLESS REGULATOR IS IN THE NEUTRAL POSITION.
5. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELLED PER SECTION 2.1.30
6. REGULATOR SL (COMMON) TERMINAL MUST BE SOLIDLY GROUNDED WHEN CONNECTING OR DISCONNECTING S (SOURCE) OR L (LOAD) TAPS TO THE PRIMARY FOR THE SAFETY OF PERSONNEL AND EQUIPMENT.

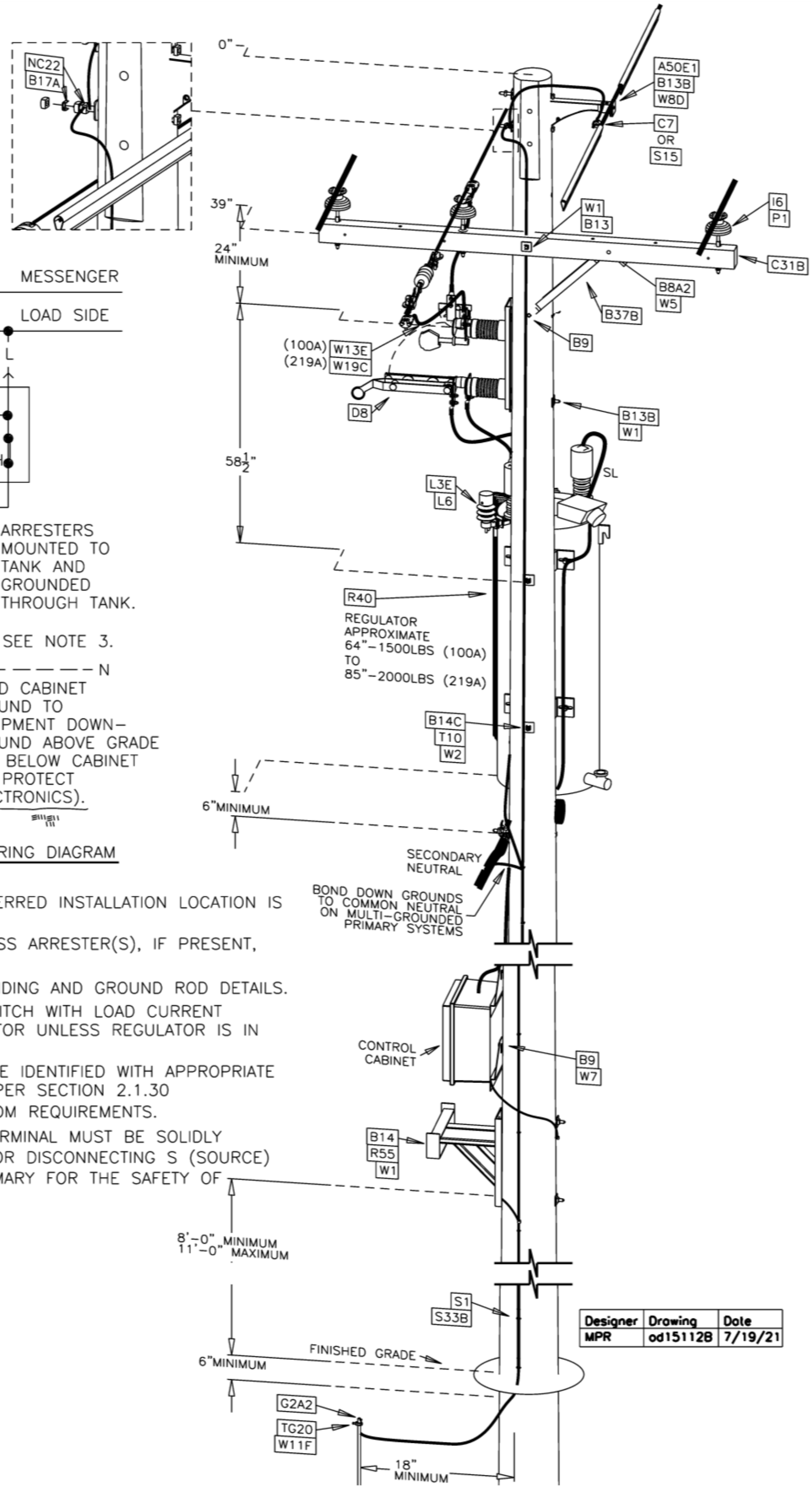
Supersedes 7/20 Issue – Update drawing to 3D

1Ø REGULATOR INSTALLATION - EFFECTIVELY GROUNDED, 15kV



NOTES:

1. WHERE PRACTICAL THE PREFERRED INSTALLATION LOCATION IS AWAY FROM VEHICULAR TRAFFIC.
2. EXTERNAL SERIES OR BY-PASS ARRESTER(S), IF PRESENT, SHOULD NOT BE DISCONNECTED.
3. SEE SECTION 13 FOR GROUNDING AND GROUND ROD DETAILS.
4. DO NOT CLOSE BY-PASS SWITCH WITH LOAD CURRENT FLOWING THROUGH THE REGULATOR UNLESS REGULATOR IS IN THE NEUTRAL POSITION.
5. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELLED PER SECTION 2.1.30
6. SEE SECTION 25 FOR TELECOM REQUIREMENTS.
7. REGULATOR SL (COMMON) TERMINAL MUST BE SOLIDLY GROUNDED WHEN CONNECTING OR DISCONNECTING S (SOURCE) OR L (LOAD) TAPS TO THE PRIMARY FOR THE SAFETY OF PERSONNEL AND EQUIPMENT.

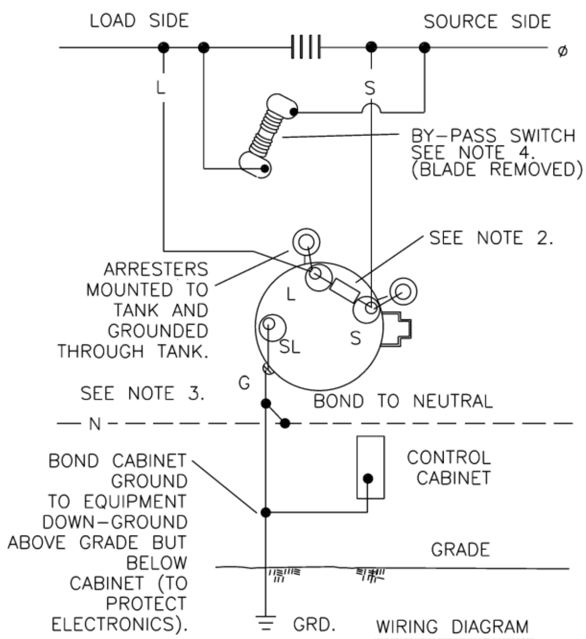


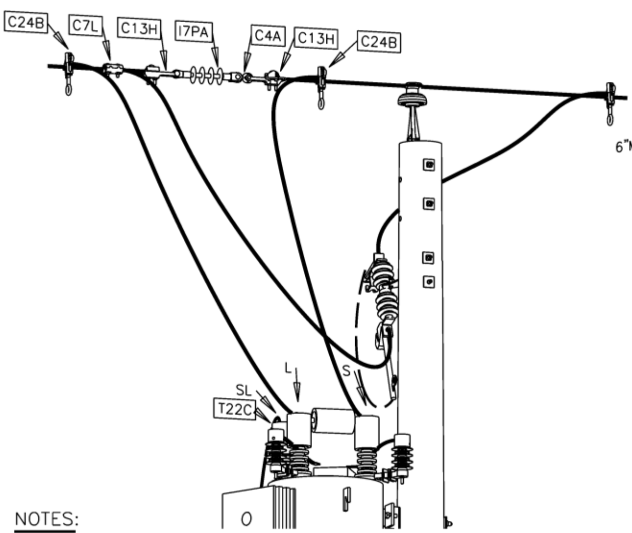
7/21 Issue – New Drawing

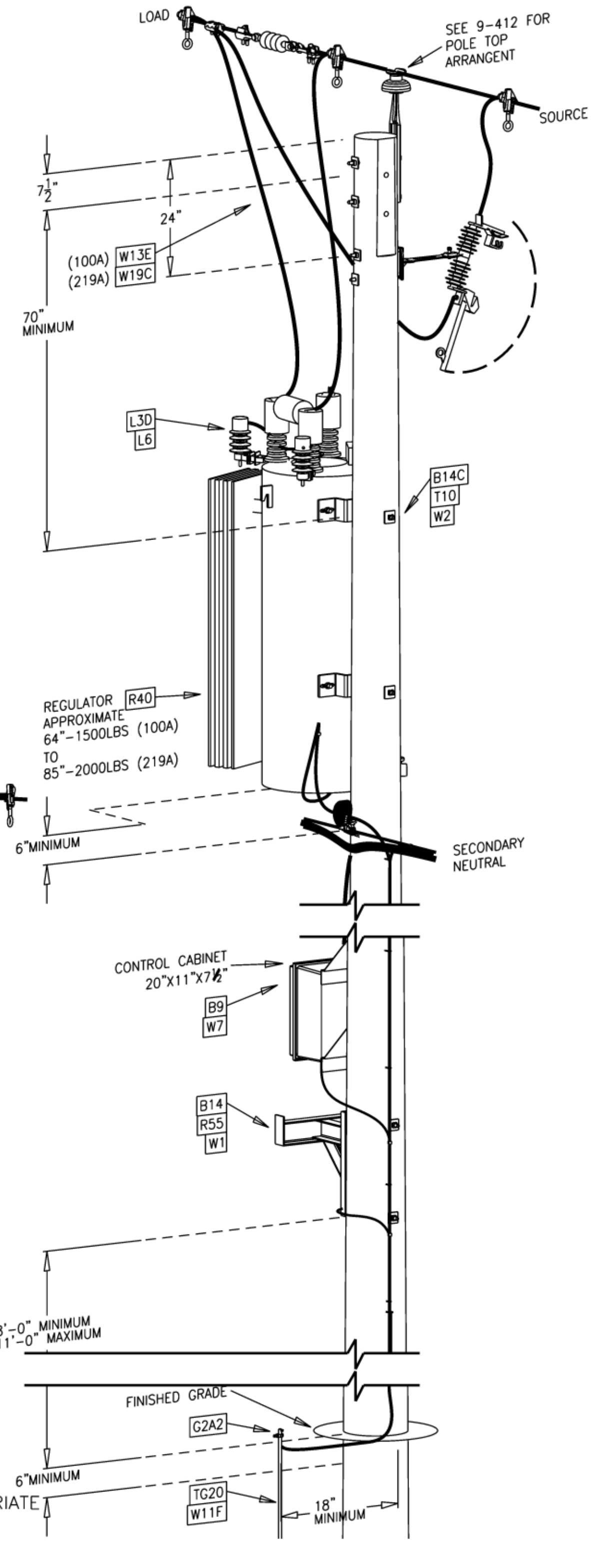
1Φ REGULATOR INSTALLATION EFFECTIVELY GROUNDED 15 KV – SPACER CABLE

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	15-112B	7/21

MU = @(C)KR590W(V)	Single Regulator, (C)=(76)=76.2kVA or (167)=167kVA (V)=(2)=2.4kV or (7)=7.62kV or (72)=7.2kV or (796)= 7.97kV







NOTES:

1. WHERE PRACTICAL THE PREFERRED INSTALLATION LOCATION IS AWAY FROM VEHICULAR TRAFFIC.
2. EXTERNAL SERIES OR BY-PASS ARRESTER(S), IF PRESENT, SHOULD NOT BE DISCONNECTED.
3. REFER TO PAGES 13-111 AND 13-113 FOR GROUNDING DETAILS.
4. DO NOT CLOSE BY-PASS SWITCH WITH LOAD CURRENT FLOWING THROUGH THE REGULATOR UNLESS REGULATOR IS IN THE NEUTRAL POSITION.
5. SEE SECTION 25 FOR TELECOM REQUIREMENTS.
6. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELLED PER SECTION 2.1.30
7. REGULATOR SL (COMMON) TERMINAL MUST BE SOLIDLY GROUNDED WHEN CONNECTING OR DISCONNECTING S (SOURCE) OR L (LOAD) TAPS TO THE PRIMARY FOR THE SAFETY OF PERSONNEL AND EQUIPMENT.

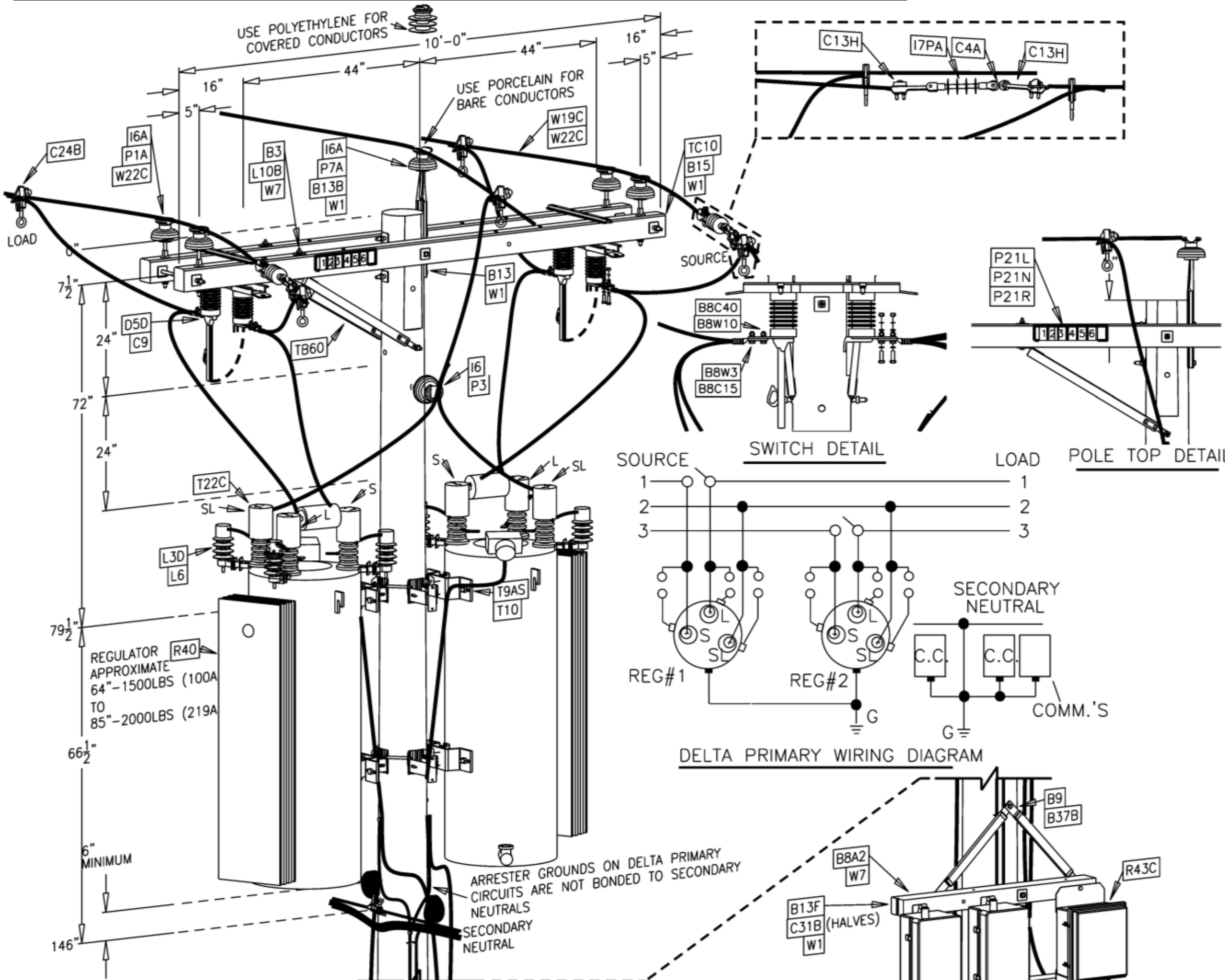
Designer	Drawing	Date
MPR	od15113	5/28/21

Supersedes 7/20 Issue – Update drawing to 3D

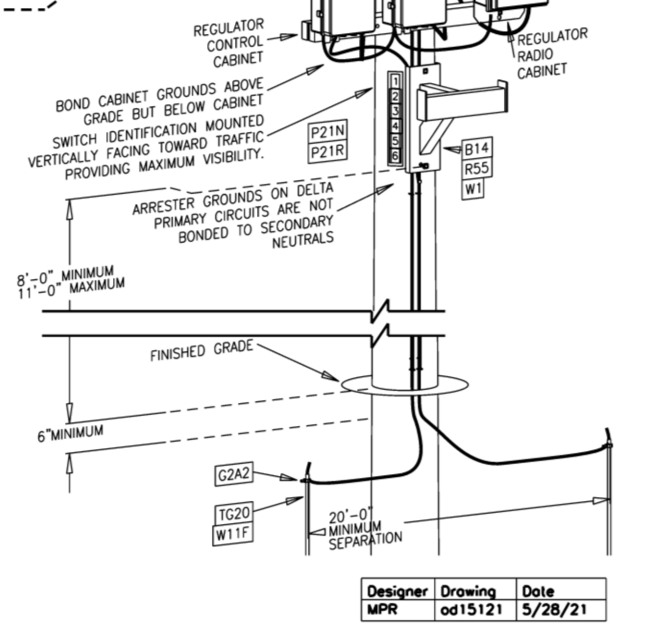
1Ø REGULATOR INSTALLATION EFFECTIVELY GROUNDED 15 kV

Supersedes 7/20 Issue – Update drawing to 3D

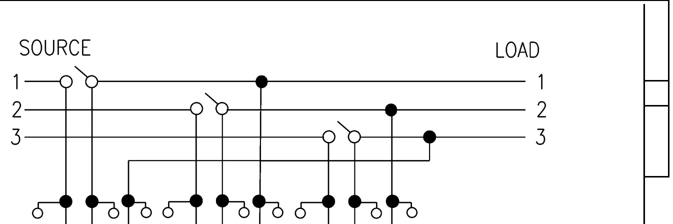
MU = @(C)K3R590D	Two Regulators, (C) = (152)=76.2kVA or (334)=167kVA @ 4.16kV
MU = @(C)K3R590D48	Two Regulators, (C) = (152)=76.2kVA or (334)=167kVA @ 4.8kV



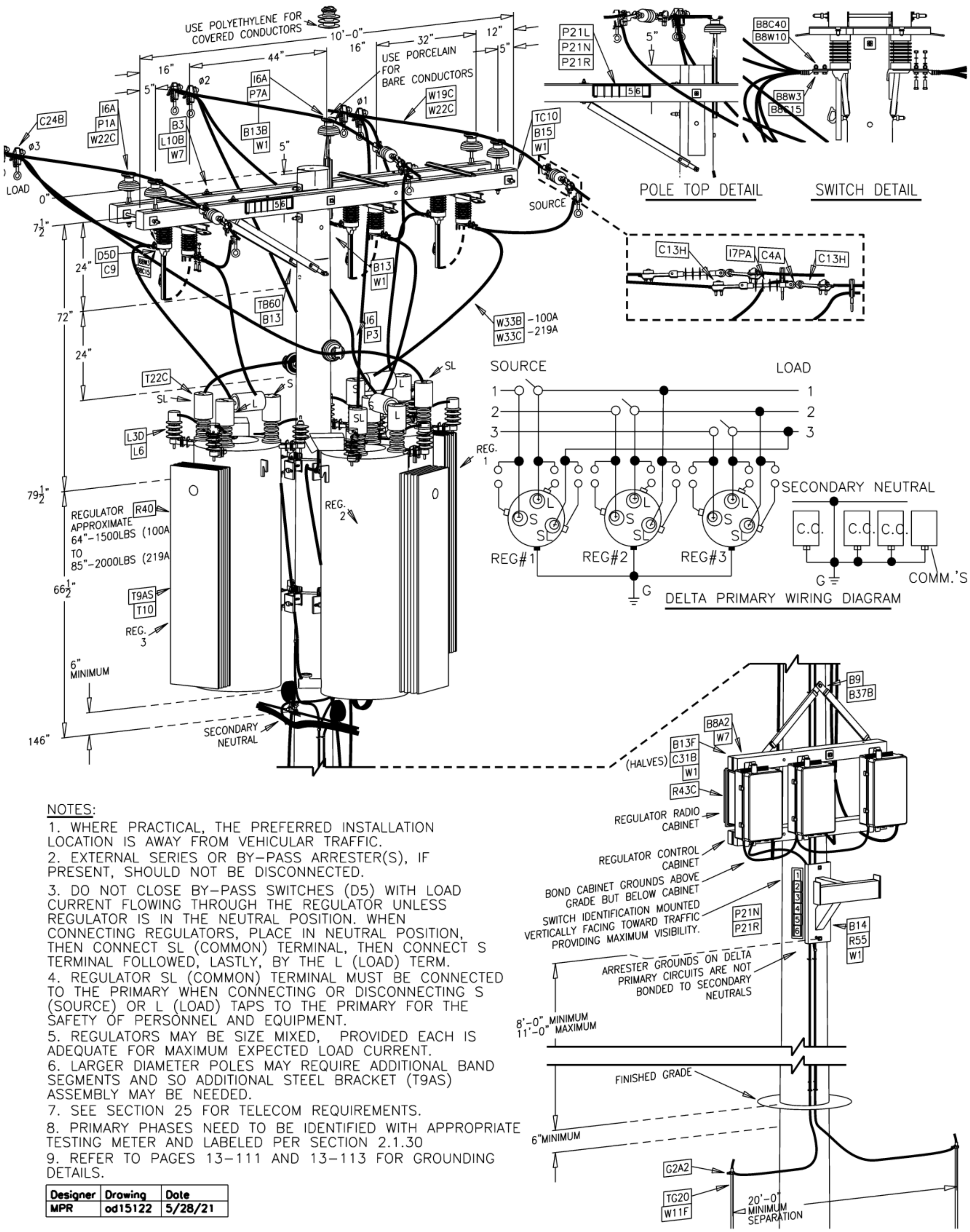
NOTES:
1. WHERE PRACTICAL, THE PREFERRED INSTALLATION LOCATION IS AWAY FROM VEHICULAR TRAFFIC.
2. EXTERNAL SERIES OR BY-PASS ARRESTER(S), IF PRESENT, SHOULD NOT BE DISCONNECTED.
3. DO NOT CLOSE BY-PASS SWITCHES (D5) WITH LOAD CURRENT FLOWING THROUGH THE REGULATOR UNLESS REGULATOR IS IN THE NEUTRAL POSITION. WHEN CONNECTING REGULATORS, PLACE IN NEUTRAL POSITION, THEN CONNECT SL (COMMON) TERMINAL, THEN CONNECT S TERMINAL FOLLOWED, LASTLY, BY THE L (LOAD) TERMINAL
4. REGULATOR SL (COMMON) TERMINAL MUST BE CONNECTED TO THE PRIMARY WHEN CONNECTING OR DISCONNECTING S (SOURCE) OR L (LOAD) TAPS TO THE PRIMARY (FOR THE SAFETY OF PERSONNEL AND EQUIPMENT).
5. REGULATORS MAY BE SIZE MIXED, PROVIDED EACH IS ADEQUATE FOR MAXIMUM EXPECTED LOAD CURRENT.
6. PHASES REGULATED MAY BE OTHER THAN SHOWN.
7. LARGER DIAMETER POLES MAY REQUIRE ADDITIONAL BAND SEGMENTS AND SO ADDITIONAL STEEL BRACKET (T9AS) ASSEMBLY MAY BE NEEDED.
8. SEE SECTION 25 FOR TELECOM REQUIREMENTS.
9. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30
10. REFER TO PAGES 13-111 AND 13-113 FOR GROUNDING DETAILS.



NOTES:
1. LOCATE INSTALLATION AWAY FROM VEHICULAR TRAFFIC.
2. EXTERNAL SERIES OR BY-PASS ARRESTER(S), IF PRESENT, SHOULD NOT BE DISCONNECTED.
3. DO NOT CLOSE BY-PASS SWITCHES (D5) WITH LOAD CURRENT FLOWING THROUGH THE REGULATOR UNLESS REGULATOR IS IN THE NEUTRAL POSITION. WHEN CONNECTING REGULATORS, PLACE IN NEUTRAL POSITION, THEN CONNECT SL (COMMON) TERMINAL, THEN CONNECT S TERMINAL FOLLOWED, LASTLY, BY THE L (LOAD) TERM.
4. REGULATOR SL (COMMON) TERMINAL MUST BE CONNECTED TO THE



MU = @(C)K3R590D	Three Regulators, (C)=(228)= 76.2kVA or (501)=167kVA @4.16kV
MU = @(C)K3R590D48	Three Regulators, (C)=(228)= 76.2kVA or (501)=167kVA @4.8kV



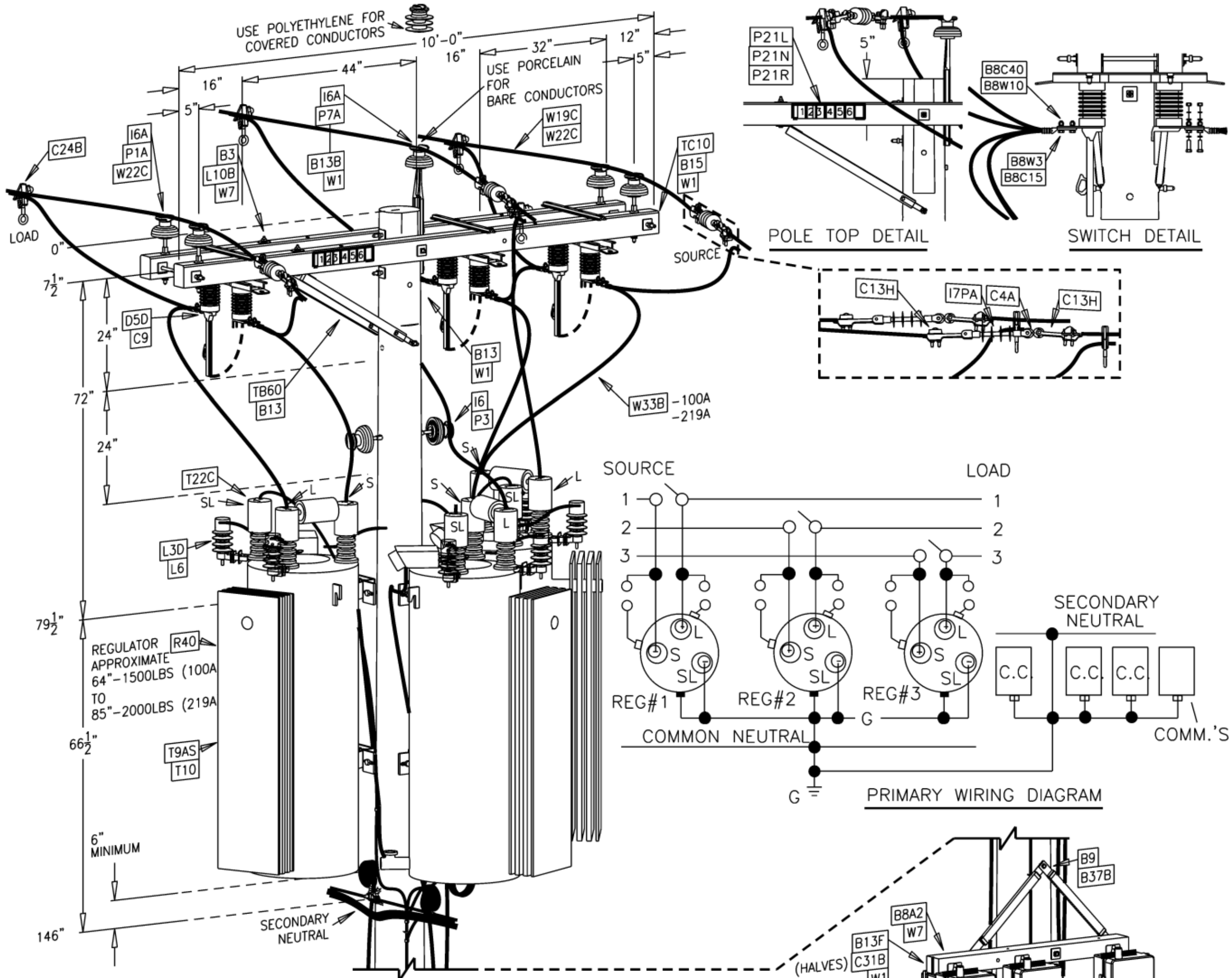
Supersedes 7/20 Issue – Update drawing to 3D

NOTES:
1. WHERE PRACTICAL, THE PREFERRED INSTALLATION LOCATION IS AWAY FROM VEHICULAR TRAFFIC.
2. EXTERNAL SERIES OR BY-PASS ARRESTER(S), IF PRESENT, SHOULD NOT BE DISCONNECTED.
3. DO NOT CLOSE BY-PASS SWITCHES (D5) WITH LOAD CURRENT FLOWING THROUGH THE REGULATOR UNLESS REGULATOR IS IN THE NEUTRAL POSITION. WHEN CONNECTING REGULATORS, PLACE IN NEUTRAL POSITION, THEN CONNECT SL (COMMON) TERMINAL, THEN CONNECT S TERMINAL FOLLOWED, LASTLY, BY THE L (LOAD) TERM.
4. REGULATOR SL (COMMON) TERMINAL MUST BE CONNECTED TO THE PRIMARY WHEN CONNECTING OR DISCONNECTING S (SOURCE) OR L (LOAD) TAPS TO THE PRIMARY FOR THE SAFETY OF PERSONNEL AND EQUIPMENT.
5. REGULATORS MAY BE SIZE MIXED, PROVIDED EACH IS ADEQUATE FOR MAXIMUM EXPECTED LOAD CURRENT.
6. LARGER DIAMETER POLES MAY REQUIRE ADDITIONAL BAND SEGMENTS AND SO ADDITIONAL STEEL BRACKET (T9AS) ASSEMBLY MAY BE NEEDED.
7. SEE SECTION 25 FOR TELECOM REQUIREMENTS.
8. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30
9. REFER TO PAGES 13-111 AND 13-113 FOR GROUNDING DETAILS.

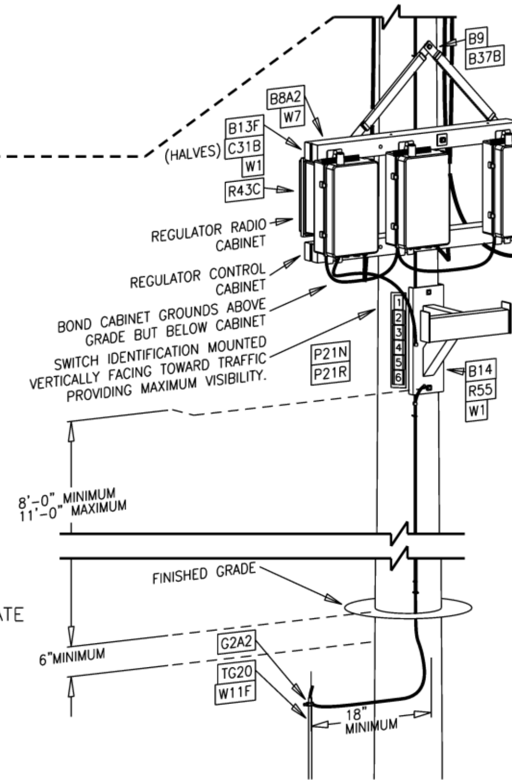
Designer	Drawing	Date
MPR	od15122	5/28/21

3Φ REGULATOR INSTALLATION NOT EFFECTIVELY GROUNDED 15 KV

MU = @(C)K3R590D	Three Regulators, (C) = (228)=76.2kVA or (501)=167kVA (V) = (416/24)=2.4kV or (124/72)=12.4/7.2kV or (132/76)=7.62kV or (138/7.9)=13.8/7.9kV



NOTES:
1. WHERE PRACTICAL, THE PREFERRED INSTALLATION LOCATION IS AWAY FROM VEHICULAR TRAFFIC.
2. EXTERNAL SERIES OR BY-PASS ARRESTER(S), IF PRESENT, SHOULD NOT BE DISCONNECTED.
3. DO NOT CLOSE BY-PASS SWITCHES (D5) WITH LOAD CURRENT FLOWING THROUGH THE REGULATOR UNLESS REGULATOR IS IN THE NEUTRAL POSITION. WHEN CONNECTING REGULATORS, PLACE IN NEUTRAL POSITION, THEN CONNECT SL (COMMON) TERMINAL, THEN CONNECT S TERMINAL FOLLOWED, LASTLY, BY THE L (LOAD) TERM.
4. REGULATOR SL (COMMON) TERMINAL MUST BE SOLIDLY GROUNDED WHEN CONNECTING OR DISCONNECTING S (SOURCE) OR L (LOAD) TAPS TO THE PRIMARY FOR THE SAFETY OF PERSONNEL AND EQUIPMENT.
5. REGULATORS MAY BE SIZE MIXED, PROVIDED EACH IS ADEQUATE FOR MAXIMUM EXPECTED LOAD CURRENT.
6. LARGER DIAMETER POLES MAY REQUIRE ADDITIONAL BAND SEGMENTS AND SO ADDITIONAL STEEL BRACKET (T9AS) ASSEMBLY MAY BE NEEDED.
7. SEE SECTION 25 FOR TELECOM REQUIREMENTS.
8. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30
9. REFER TO PAGES 13-111 AND 13-113 FOR GROUNDING DETAILS.

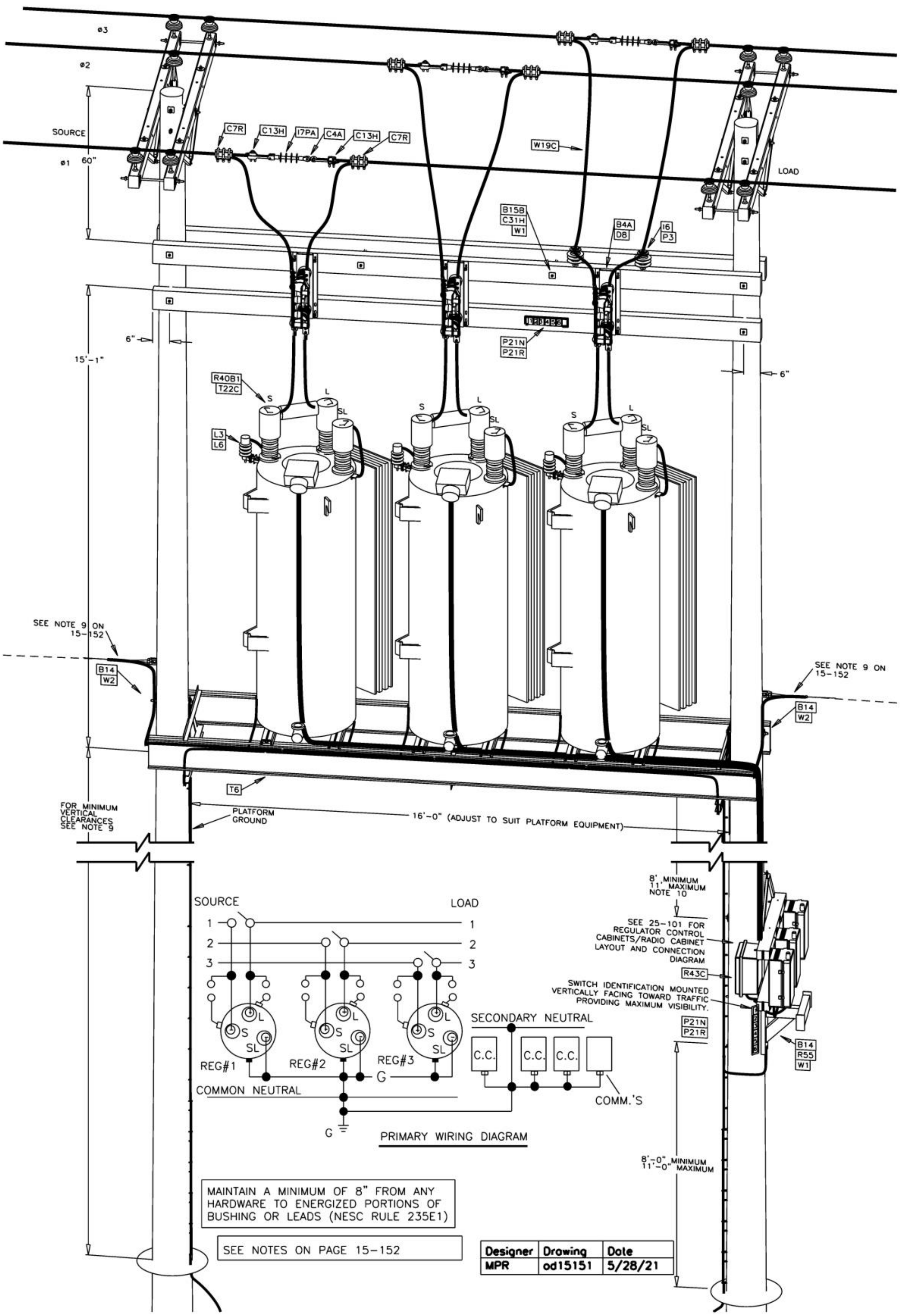


Designer	Drawing	Date
MPR	od15131	5/28/21

Supersedes 7/20 Issue – Update drawing to 3D

3Φ REGULATOR INSTALLATION EFFECTIVELY GROUNDED 15 KV

MU=@(C)K3R590W(V)PF	Three Regulators, (C)=(501)=167kVA or (999)=333kVA (V)=(416/24)=2.4kV or (124/7)=12.4/7.2kV or (13.2/76)=7.62kV or (138/7.9)=13.8/7.9kV

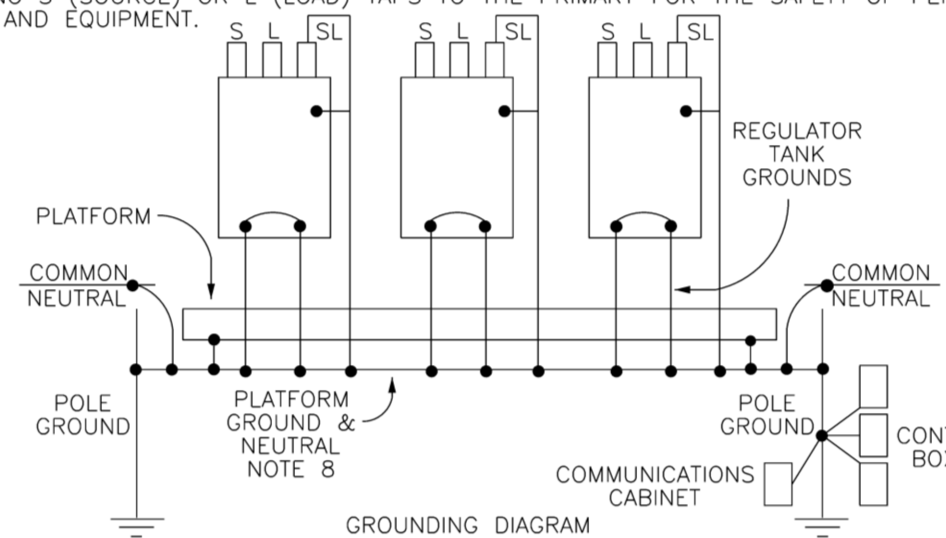


Supersedes 7/19 Issue – Update drawing to 3D

REGULATORS PLATFORM INSTALLATION EFFECTIVELY GROUNDED SYSTEM			
ISSUE	**PAGE NUMBER**	**OVERHEAD CONSTRUCTION STANDARD**	ppl
7/21	**15-151**		

NOTES FOR DRAWING 15–151:

1. DIMENSIONS MAY VARY BASED ON SWITCH DESIGN.
2. ARRESTERS MUST BE INSTALLED ON BOTH LOAD AND SOURCE SIDE BUSHINGS.
3. MINIMUM CLASS 3 POLES FOR POLES 50 FEET OR SHORTER. MINIMUM CLASS 2 POLES FOR POLES 55 FEET OR LONGER.
4. MOUNT THE PLATFORM TO THE POLES WITH 3/4" BOLTS.
5. USE TIE–DOWN CLIPS ON PLATFORM TO FASTEN REGULATORS.
6. INSTALL ANIMAL GUARDS ON ALL REGULATOR AND ARRESTER BUSHINGS.
7. CAUTION: REGULATORS MUST ALWAYS HAVE THEIR TAP CHANGERS IN THE NEUTRAL POSITION BEFORE THE REGULATOR BYPASS SWITCH IS OPERATED OR THEY ARE PUT ON OR TAKEN OFF AN ENERGIZED LINE OTHERWISE, A VIOLENT REGULATOR FAILURE COULD OCCUR. REFER TO EOP D003 FOR MORE DETAILS.
8. PLATFORM GROUND AND NEUTRAL CONDUCTOR SHALL BE THE SAME SIZE AS OR LARGER THAN THE SYSTEM NEUTRAL.
9. FOR SPACES AND WAYS SUBJECT TO PEDESTRIANS OR RESTRICTED TRAFFIC ONLY, THE MINIMUM VERTICAL CLEARANCE MAY BE REDUCED TO 11'–0", PER NESC RULE 232B3. NOTE: SUCH LOCATIONS ARE VERY UNUSUAL.
10. CAUTION: MINIMUM VERTICAL DISTANCE FROM THE TOP OF THE CONTROL BOX TO THE LOWEST POINT OF THE PLATFORM IS 8'–0".
11. CARE SHOULD BE TAKEN TO INSTALL PLATFORM STRUCTURES IN LOCATIONS WHERE THEIR VISIBILITY TO THE PUBLIC IS MINIMIZED.
12. GROUND MAT IS REQUIRED FOR CONTROL CABINETS MOUNTED LESS THAN 8' ABOVE GRADE. SEE STANDARDS AT 13–113 FOR DETAILS.
13. CONTROL CABINETS MAY BE MOUNTED AT 8'–0" TO 11'–0" ABOVE GRADE WITH LADDER BRACKET, SIMILAR TO CABINET MOUNTING ARRANGEMENT IN DRAWING 15–122.
14. THE LOWEST PART OF THE GROUNDED PLATFORM (SIDE RAILS, BRACES, OR SUPPORT BRACKETS) SHALL BE AT LEAST 40" ABOVE ANY VERIZON OWNED WIRE OR CABLE AND AT LEAST 30" ABOVE ANY OTHER COMMUNICATION WIRE OR CABLE.
15. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30
16. SEE SECTION 15.4.20 FOR INFORMATION ON INSTALLATION ORIENTATION OF PLATFORM MOUNTED REGULATORS.
17. REGULATOR SL (COMMON) TERMINAL MUST BE SOLIDLY GROUNDED WHEN CONNECTING OR DISCONNECTING S (SOURCE) OR L (LOAD) TAPS TO THE PRIMARY FOR THE SAFETY OF PERSONNEL REGULATORS AND EQUIPMENT.



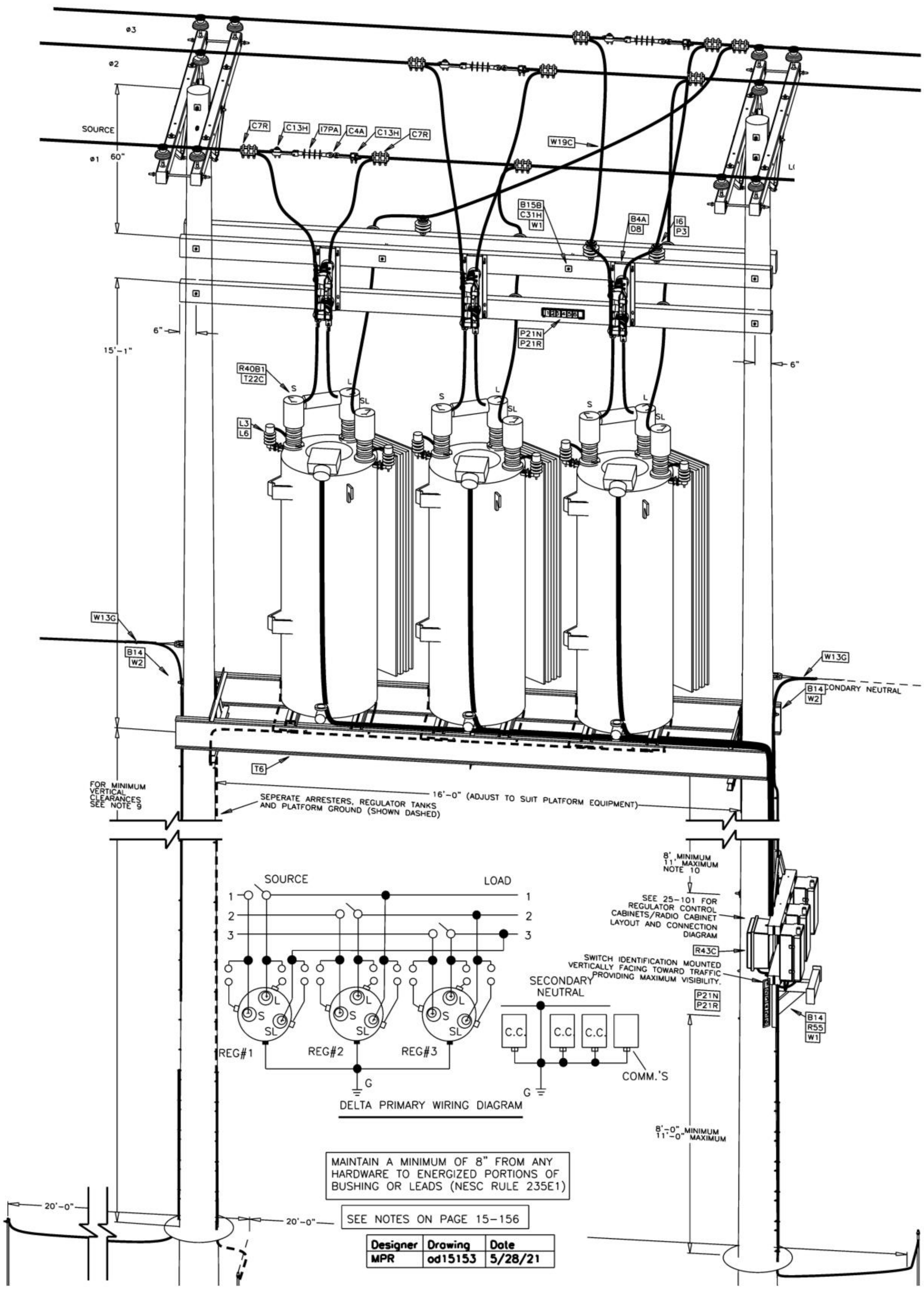
GROUNDING DIAGRAM

Designer	Drawing	Date
MPR	od15152	5/28/21

Supersedes 7/20 Issue – Update wiring diagram

REGULATORS PLATFORM INSTALLATION GROUNDING DIAGRAM - MGY SYSTEM			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 15-152	ISSUE 7/21

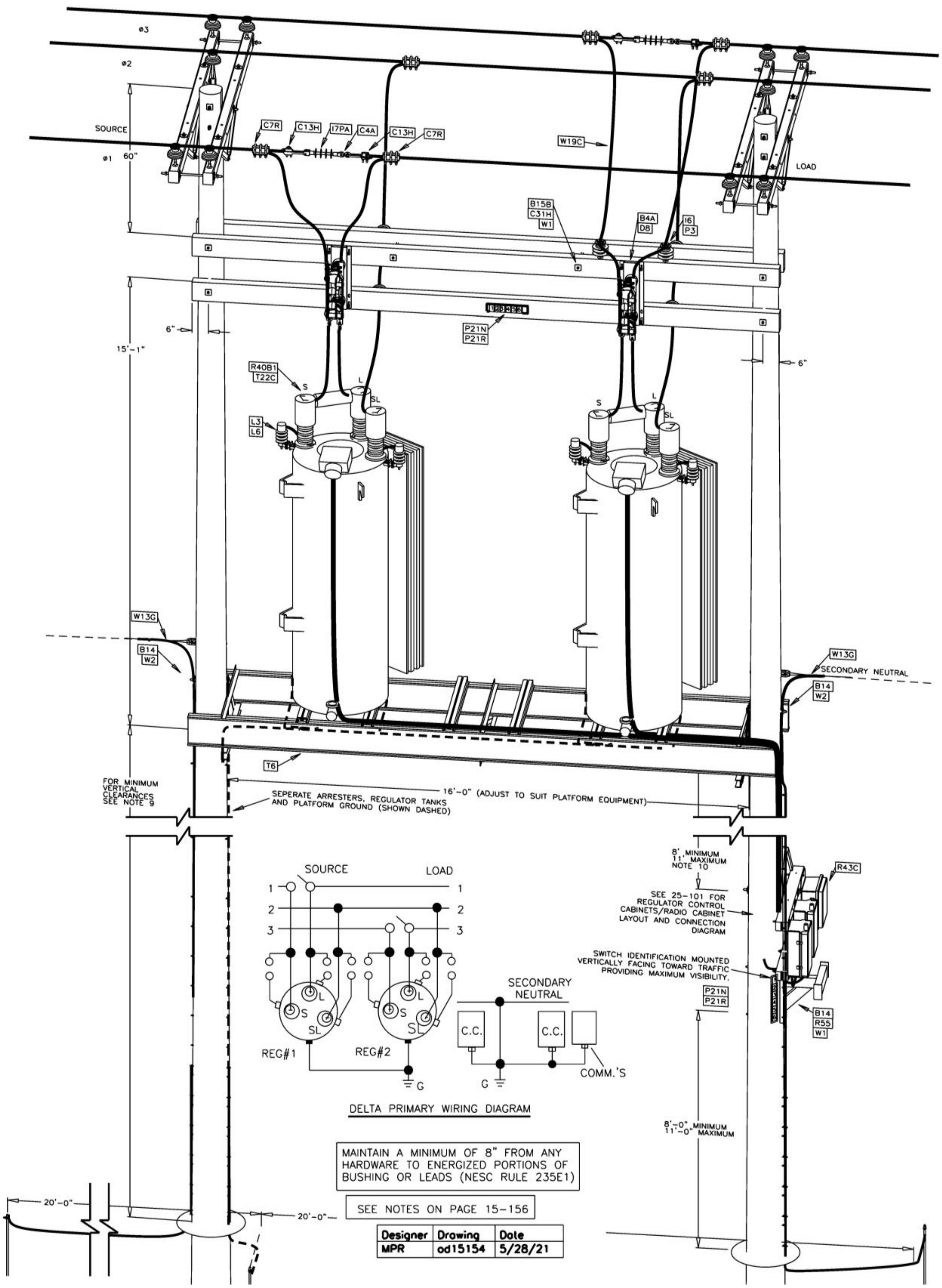
MU = @(C)K3R590D	Three Regulators, (C) = 501-167KVA ; 999- 333KVA@4.16kV
MU = @(C)K3R590D48PF	Three Regulators, (C) = 501-167KVA ; 999- 333KVA@4.8KV



Supersedes 7/19 Issue – Update drawing to 3D

REGULATOR PLATFORM DELTA INSTALLATION
2 OR 3 REGULATORS

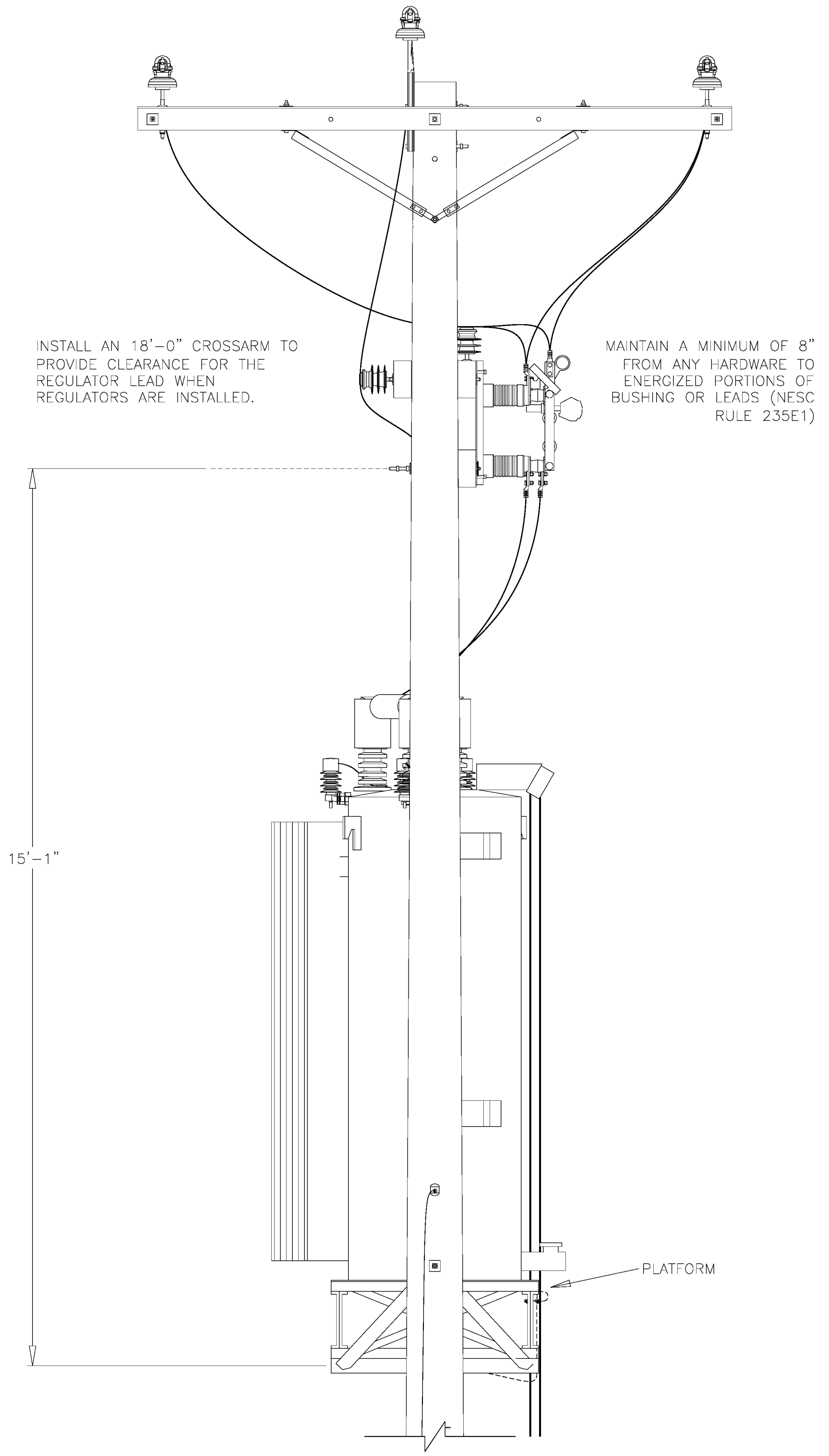
MU=@(C)K2R590DPF	Two Regulators, (C)=(334)=167kVA or (666)=333kVA@4.16kV
MU=@(C)K2R590D48PF	Two Regulators, (C)=(334)=167kVA or (666)=333kVA@4.8kV



Supersedes 7/19 Issue – Update drawing

2 REGULATOR PLATFORM INSTALLATION
DELTA SYSTEM

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	15-154	7/21



Supersedes 7/20 Issue – Updated drawing

SEE NOTES ON PAGE 15-156

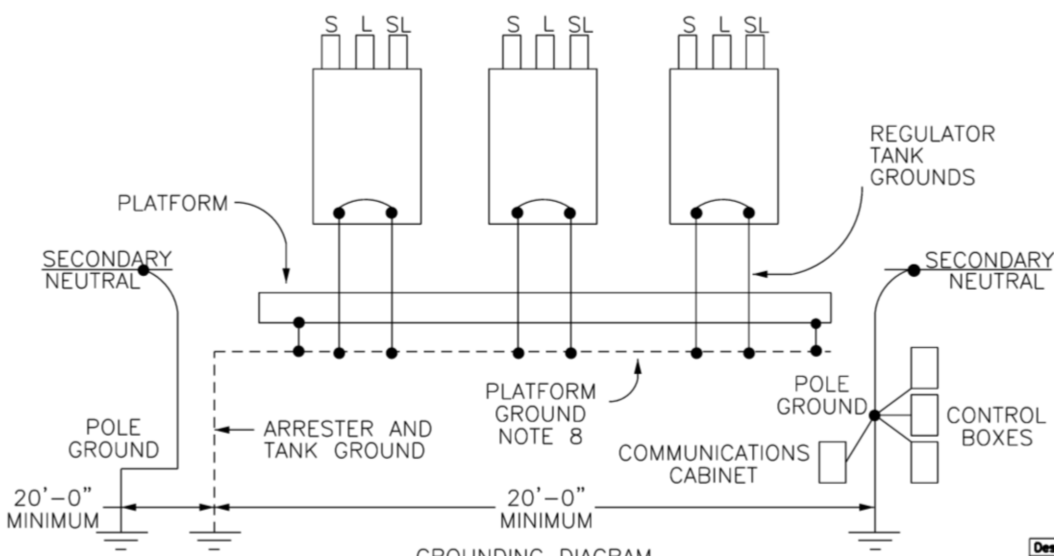
Designer	Drawing	Date
MPR	od15155	5/28/21

REGULATOR PLATFORM DELTA INSTALLATION
2 OR 3 REGULATORS (SIDE VIEW)

Supersedes 7/20 Issue – Update drawing

NOTES FOR DRAWINGS 15–153 AND 15–154:

1. DIMENSIONS MAY VARY BASED ON SWITCH DESIGN.
2. ARRESTERS MUST BE INSTALLED ON BOTH LOAD AND SOURCE SIDE BUSHINGS.
3. MINIMUM CLASS 3 POLES FOR POLES 50 FEET OR SHORTER. MINIMUM CLASS 2 POLES FOR POLES 55 FEET OR LONGER.
4. MOUNT THE PLATFORM TO THE POLES WITH 3/4" INCH BOLTS.
5. USE TIE–DOWN CLIPS ON PLATFORM TO FASTEN REGULATORS.
6. INSTALL ANIMAL GUARDS ON ALL REGULATOR AND ARRESTER BUSHINGS.
7. CAUTION: REGULATORS MUST ALWAYS HAVE THEIR TAP CHANGERS IN THE NEUTRAL POSITION BEFORE THE REGULATOR BYPASS SWITCH IS OPERATED OR THEY ARE PUT ON OR TAKEN OFF AN ENERGIZED LINE OTHERWISE, A VIOLENT REGULATOR FAILURE COULD OCCUR. REFER TO EOP D003 FOR MORE DETAILS.
8. PLATFORM GROUND SHALL BE #2 COPPER.
9. FOR SPACES AND WAYS SUBJECT TO PEDESTRIANS OR RESTRICTED TRAFFIC ONLY, THE MINIMUM VERTICAL CLEARANCE MAY BE REDUCED TO 11'–0", PER NESC RULE 232B3. NOTE: SUCH LOCATIONS ARE VERY UNUSUAL.
10. CAUTION: MINIMUM VERTICAL DISTANCE FROM THE TOP OF THE CONTROL BOX TO THE LOWEST POINT OF THE PLATFORM IS 8'–0".
11. CARE SHOULD BE TAKEN TO INSTALL PLATFORM STRUCTURES IN LOCATIONS WHERE THEIR VISIBILITY TO THE PUBLIC IS MINIMIZED.
12. GROUND MAT IS REQUIRED FOR CONTROL CABINETS MOUNTED LESS THAN 8'ABOVE GRADE. SEE STANDARDS AT 13–113 FOR DETAILS.
13. CONTROL CABINETS MAY BE MOUNTED AT 8'–11"ABOVE GRADE WITH LADDER BRACKET, SIMILAR TO CABINET MOUNTING ARRANGEMENT IN DRAWING 15–122.
14. THE LOWEST PART OF THE GROUNDED PLATFORM (SIDE RAILS, BRACES, OR SUPPORT BRACKETS) SHALL BE AT LEAST 40"ABOVE ANY VERIZON OWNED WIRE OR CABLE AND AT LEAST 30"ABOVE ANY OTHER
15. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30
16. SEE SECTION 15.4.20 FOR INFORMATION ON INSTALLATION ORIENTATION OF PLATFORM MOUNTED REGULATORS.



GROUNDING DIAGRAM

Designer	Drawing	Date
MPR	od15156	5/28/21

CU = CDBPS15KNE	Bypass Switch D8

Regulator bypass switches must not be operated until the
automatic control circuits of the associated regulator tap changers have been opened and the tap changers have been moved to the neutral position.

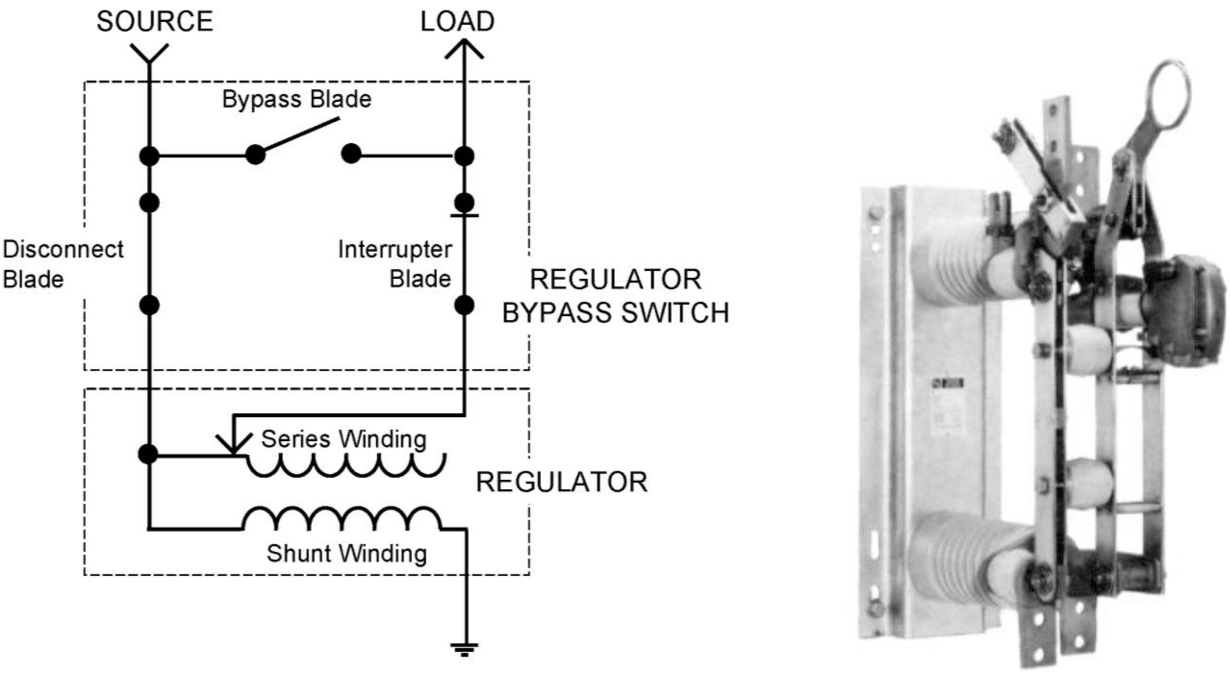


Figure 1 - Switch closed; voltage regulator is energized. Bypass blade is open; disconnect blade and interrupter blade are closed.

7/10 - New page.

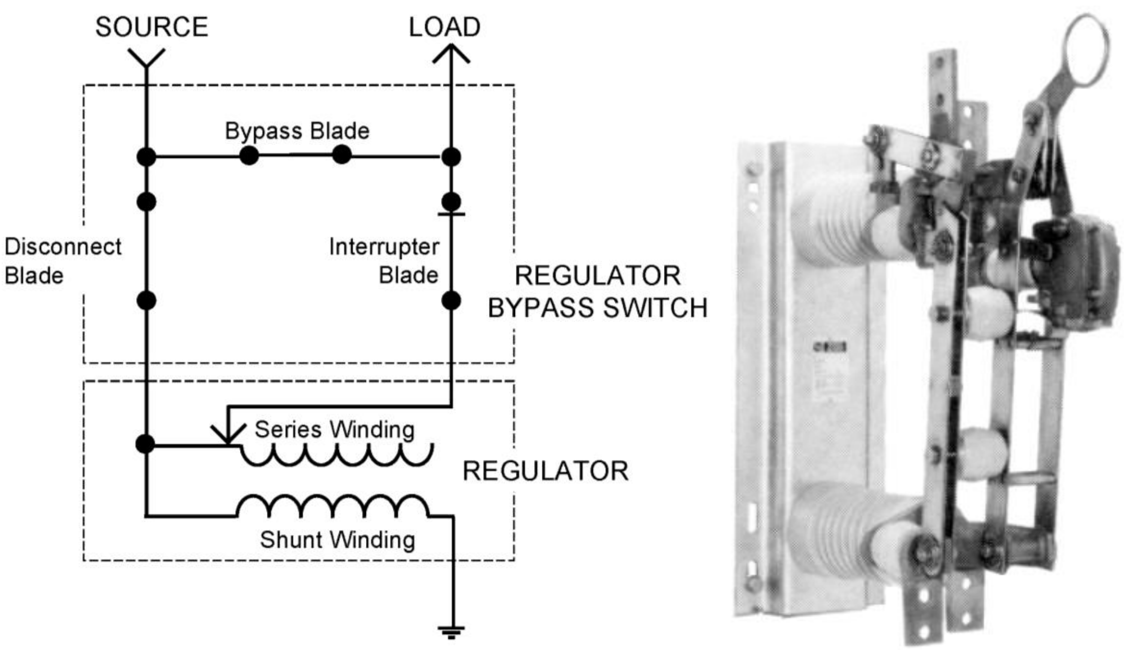


Figure 2 - Switch in early stage of opening stroke. Bypass blade has closed, making a direct connection between the source and load. Disconnect blade and interrupter blade are still closed.

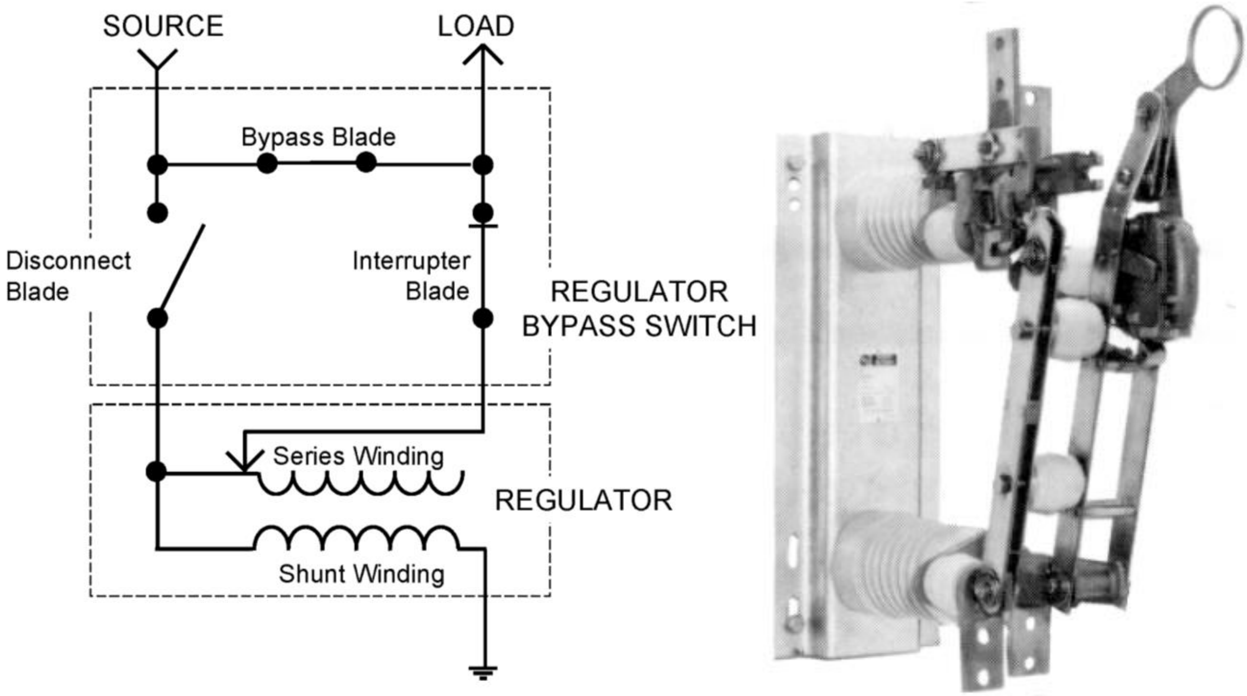


Figure 3 - Switch in later stage of opening stroke. Disconnect blade has opened, but voltage-regulator shunt winding is still energized through the interrupter blade.

7/10 - New page.

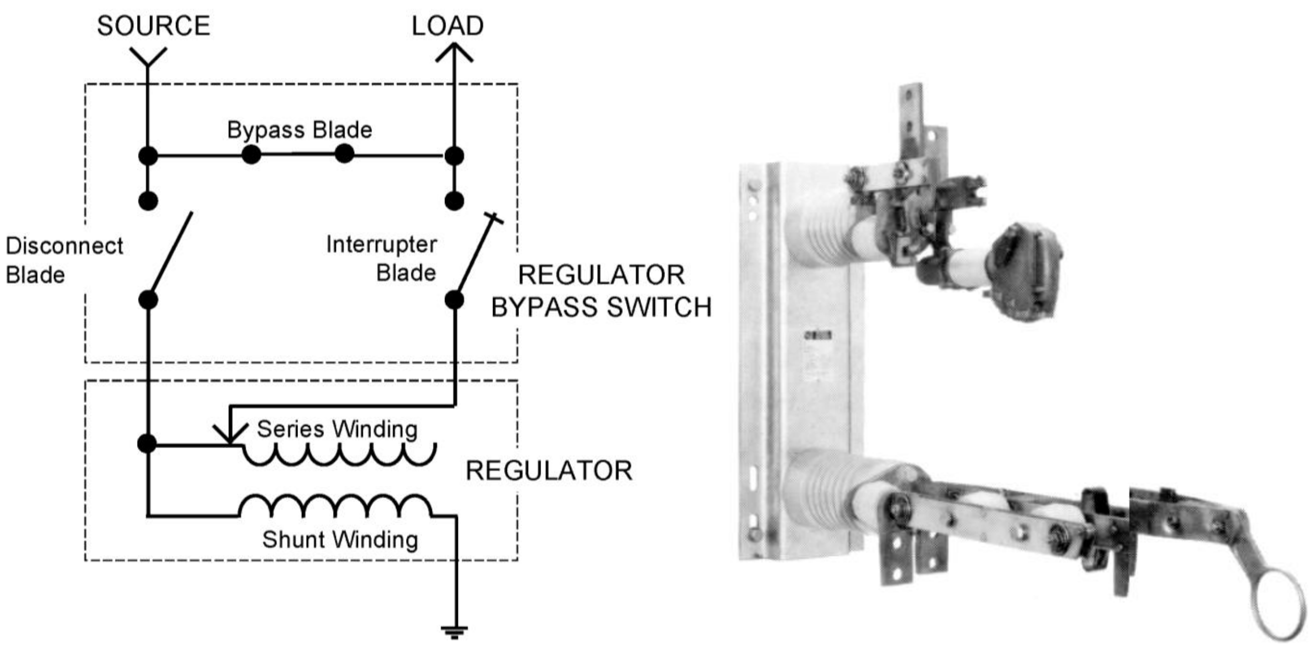
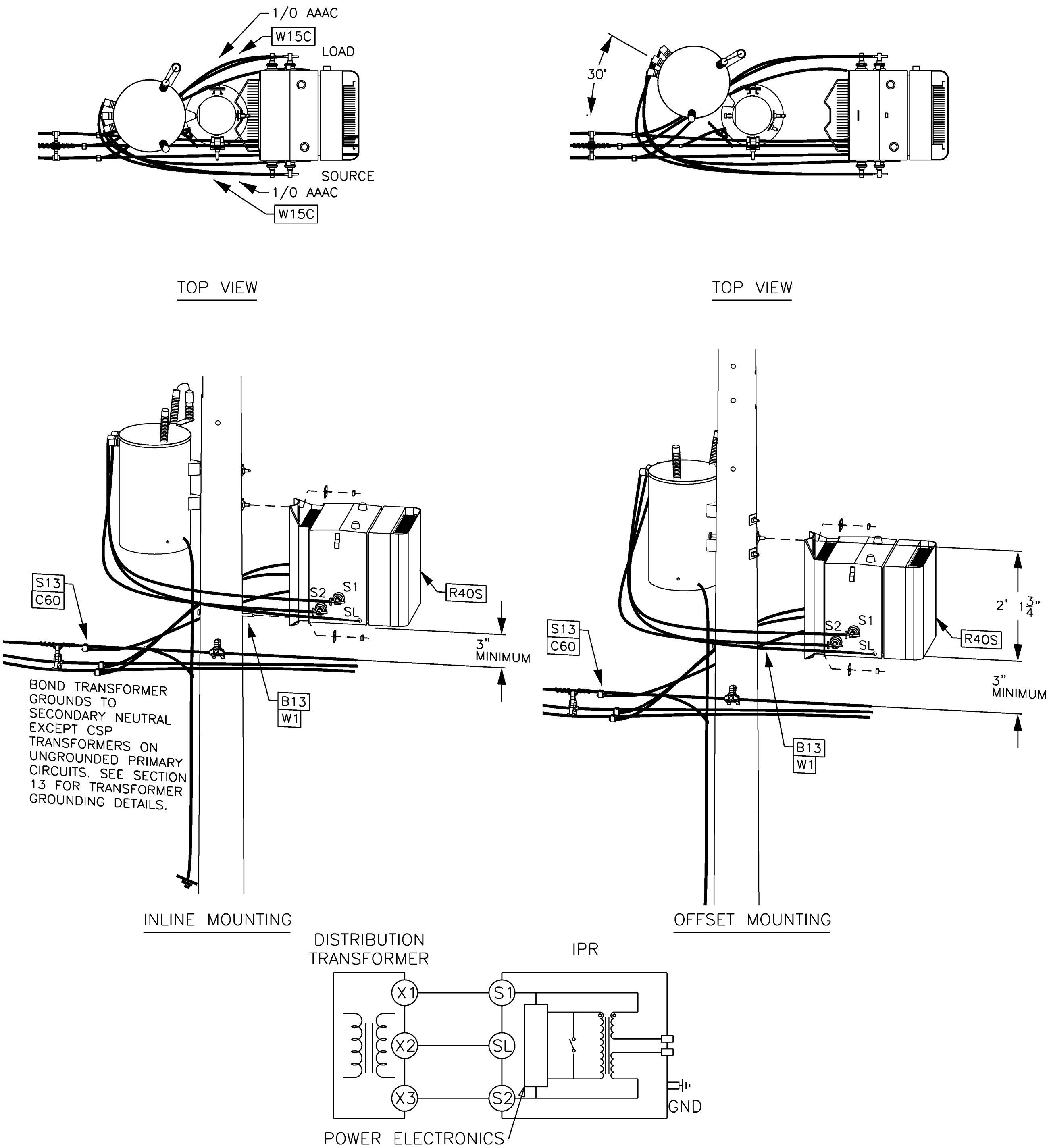


Figure 4 - Switch fully open. Voltage-regulator magnetizing-current interruption has taken place within the interrupter with no external arc or flame. Voltage regulator is de-energized and bypassed.



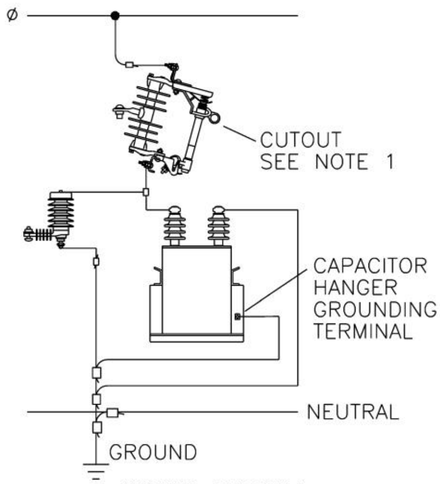
NOTE:
1. INLINE POWER REGULATOR UNIT MUST BE INSTALLED ON POLES WITH A SINGLE PHASE POLE TYPE DISTRIBUTION TRANSFORMER RATED 50KVA OR LESS THAT IS CONNECTED PHASE TO GROUNDED WYE SYSTEM WITH A PRIMARY VOLTAGE OF 8.7KV OR LESS AND A SECONDARY VOLTAGE OF 120V/240V.

Supersedes 7/17 Issue – Added Offset Mounting and Connection Drawings.

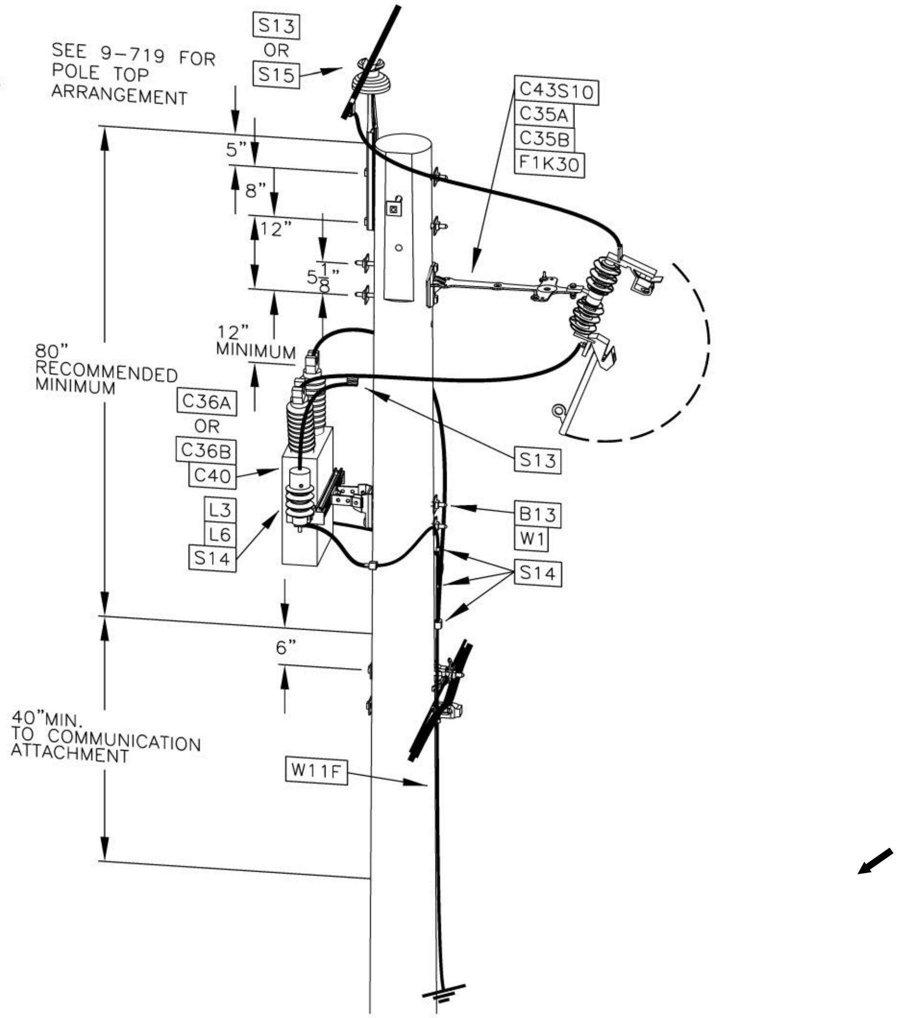
Designer	Drawing	Date
MPR	od15160	6/30/20

IN-LINE POWER REGULATOR – 120/240V, 50kVA

Supersedes 7/11 Issue – Update drawing to 3D.



WIRING DIAGRAM

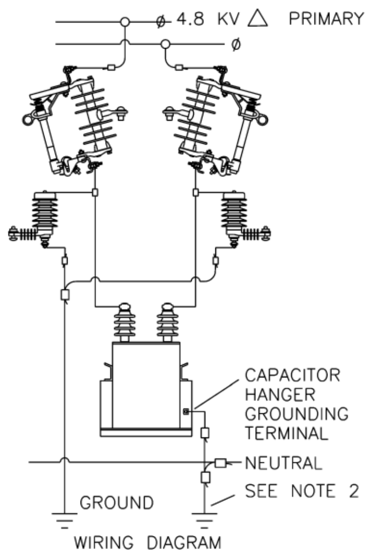


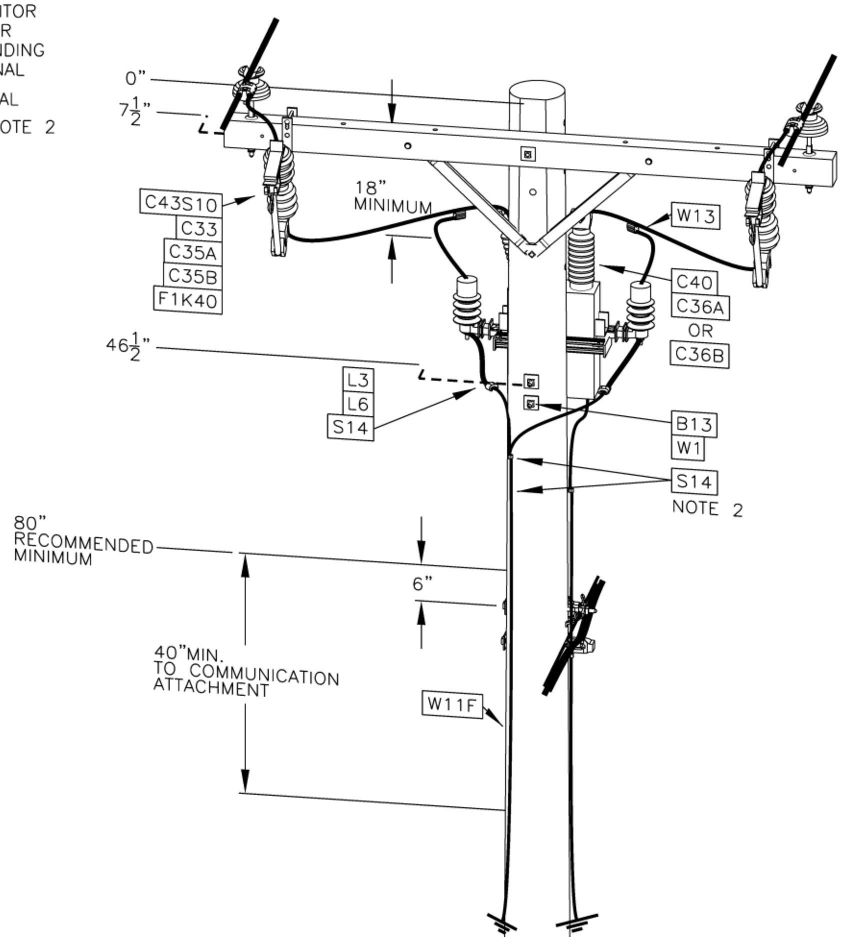
NOTES
1. USE CUTOUT AND FUSE SIZE AS SHOWN IN SECTION 12.
2. SEE SECTION 5 FOR CONNECTORS

Designer	Drawing	Date
MPR	od15211	5/14/21

1Ø CAPACITOR INSTALLATION EFFECTIVELY GROUNDED 15 kV			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 15-211	ISSUE 7/21

MU=@TCS(E)C(V)NE MU=@TCS(E)C416UNGRDYNE MU=@TCS(E)C24DNE	(E) = kVAR Size, (V) = Voltage





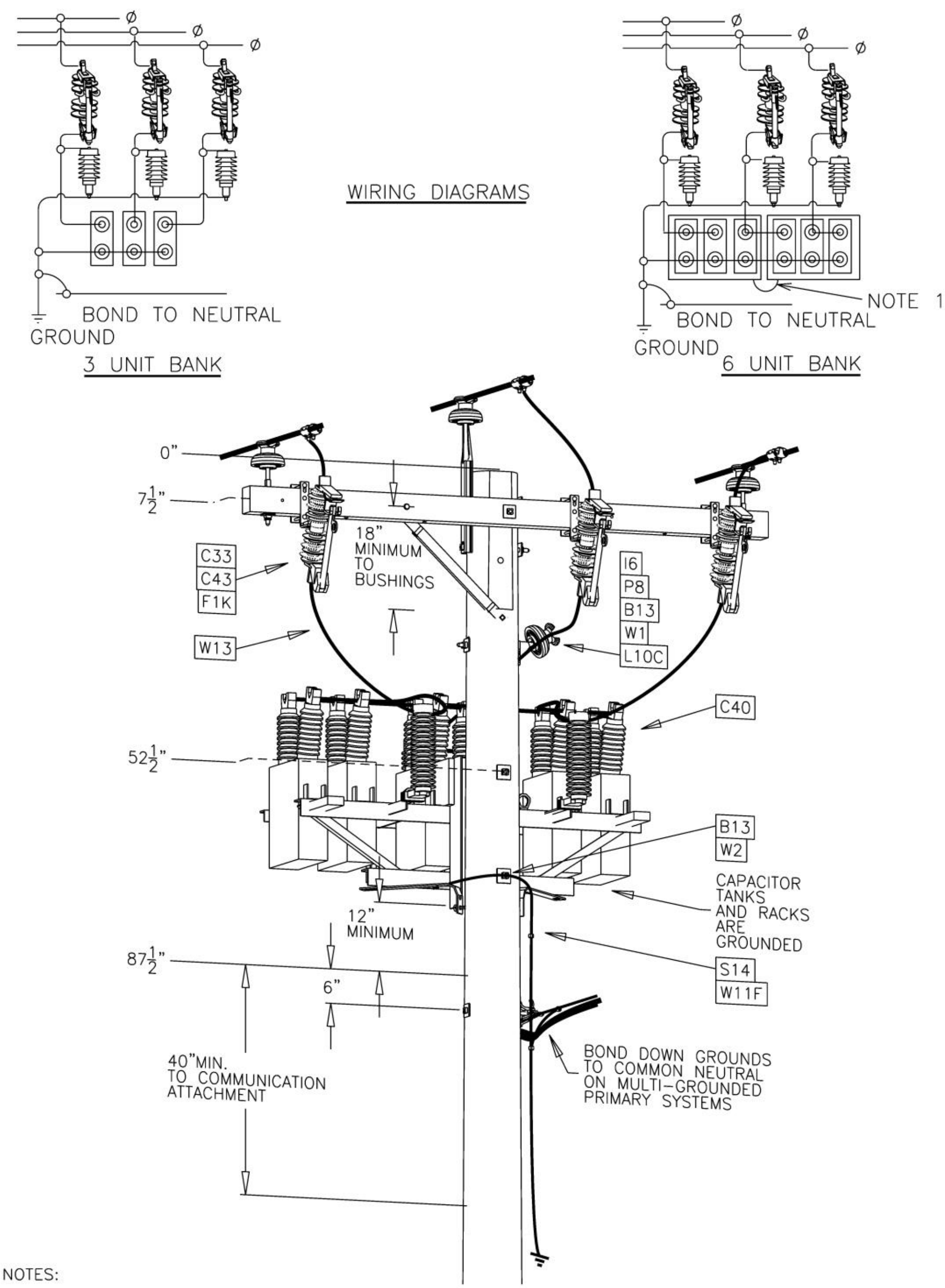
Supersedes 7/11 – Update drawing to 3D.

NOTES:

1. FOR USE WITH 25 , 50 AND 100 KVAR, 1| UNITS.
   25 KVAR UNITS NOT RECOMMENDED FOR NEW PURCHASES.
2. ON DELTA PRIMARY SYSTEMS THE SURGE ARRESTER GROUNDING CONDUCTOR AND THE SECONDARY NEUTRAL GROUNDING CONDUCTOR SHALL BE RUN SEPARATELY TO TWO GROUND RODS. SEE SECTION 13 FOR GROUNDING DETAILS.
3. USE CUTOUT AND FUSE SIZE AS SHOWN IN SECTION 12.

Designer	Drawing	Date
MPR	od15212	5/28/21

MU = @(E)KB(V)YFNE	(E) = kVAR Size, (V) = Voltage



NOTES:
1. BOND SEPARATE CAPACITOR RACKS TOGETHER.

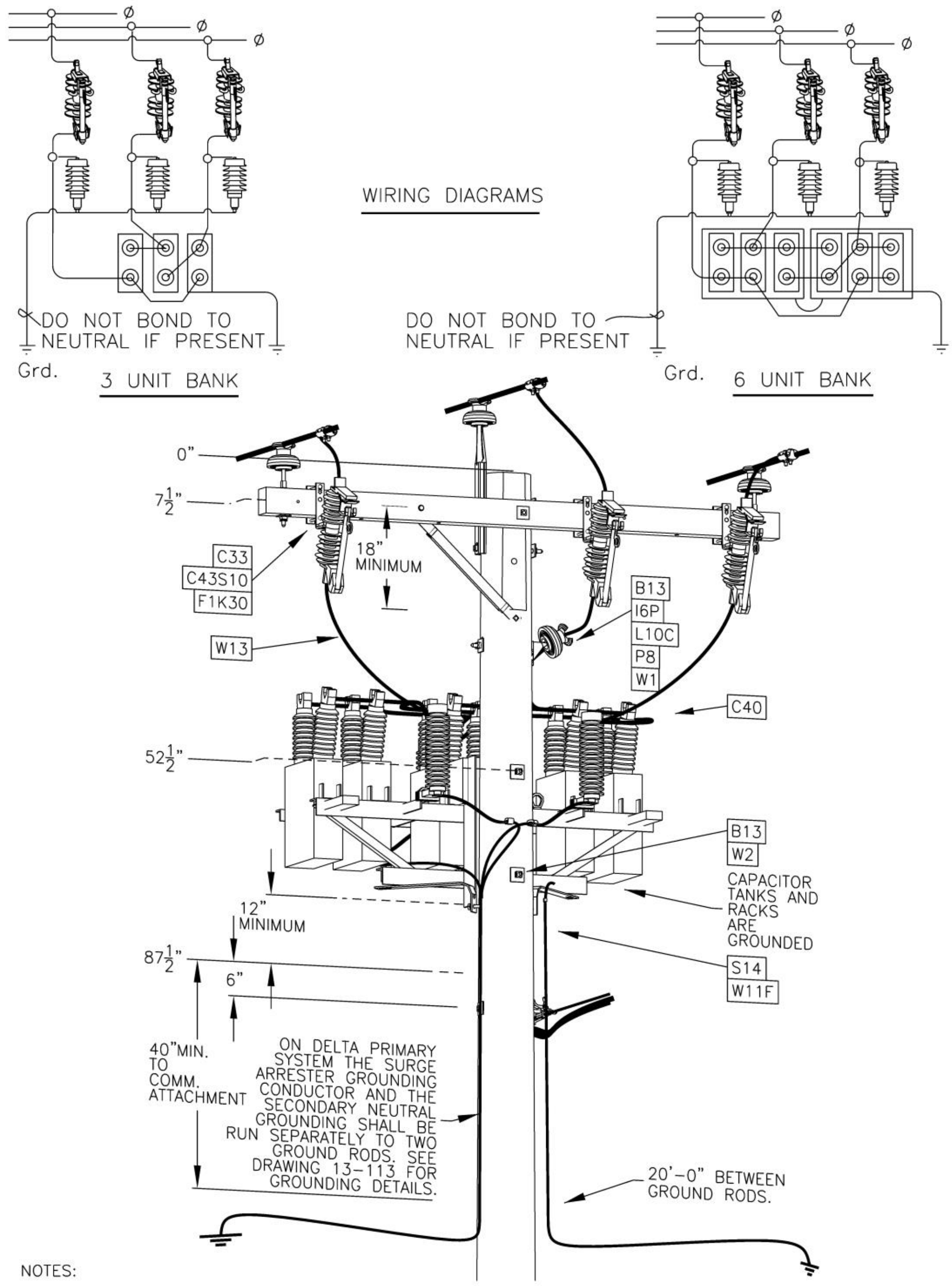
Designer	Drawing	Date
MPR	od15331	5/28/21

Supersedes 7/21 Issue – Update drawing to 3D.

3Ø FIXED CAPACITOR INSTALLATION EFFECTIVELY GROUNDED 15 kV

	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
ppl		15-331	7/21

MU = @(E)KB(V)DFNE	(E) = kVAR Size, (V) = Voltage



NOTES:

1. BOND SEPARATE CAPACITOR RACKS TOGETHER

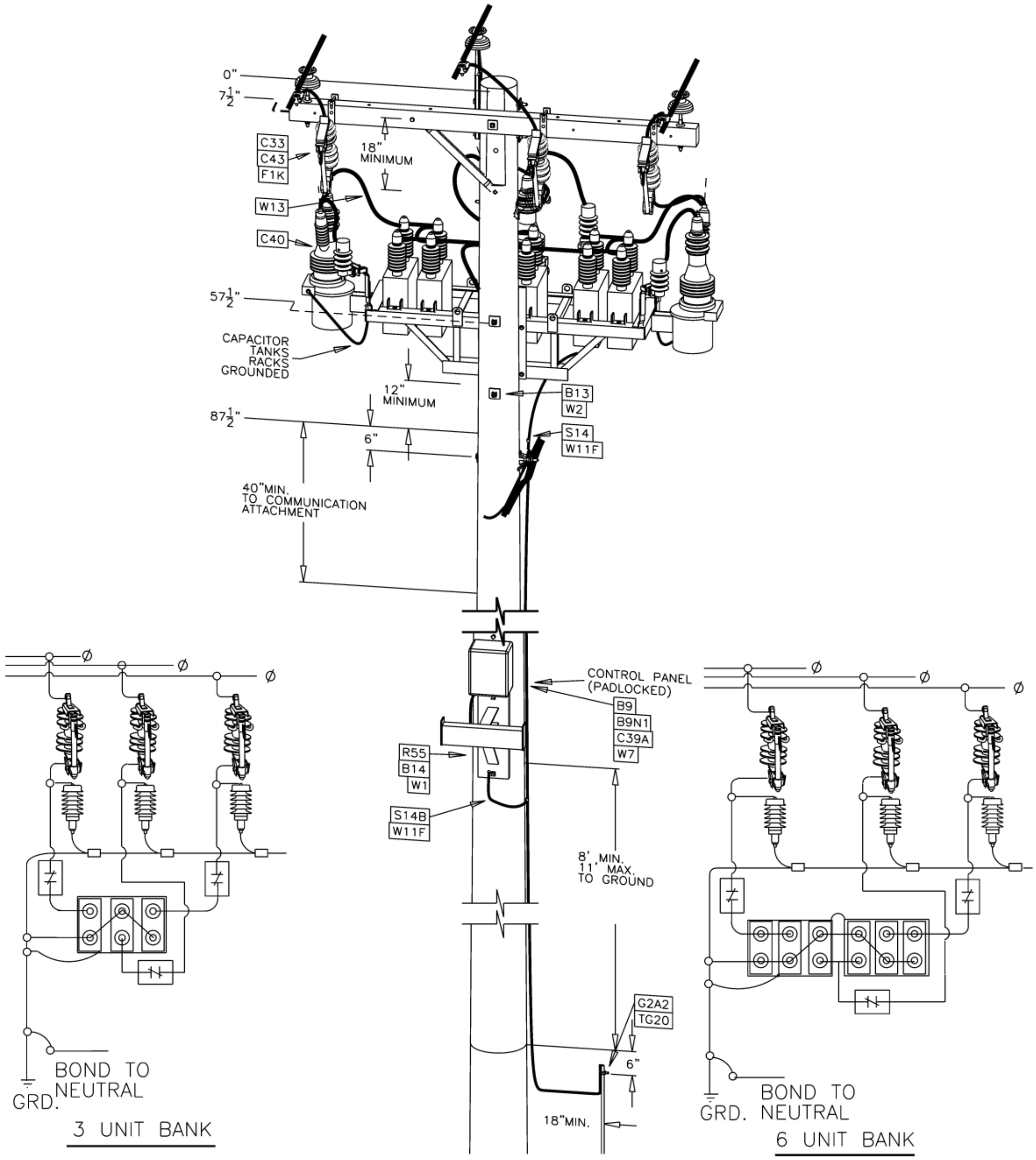
Designer	Drawing	Date
MPR	od15332	5/28/21

Supersedes 7/20 Issue – Update drawing to 3D.

3Ø FIXED CAPACITOR INSTALLATION NOT EFFECTIVELY GROUNDED 15 kV

MU = @(E)KB(V)YSW or YSWNE	(E) = kVAR Size, (V) = Voltage
MU = @(E)K3C(V)YSWNE	

Supersedes 7/20 Issue – Update drawing to 3D.

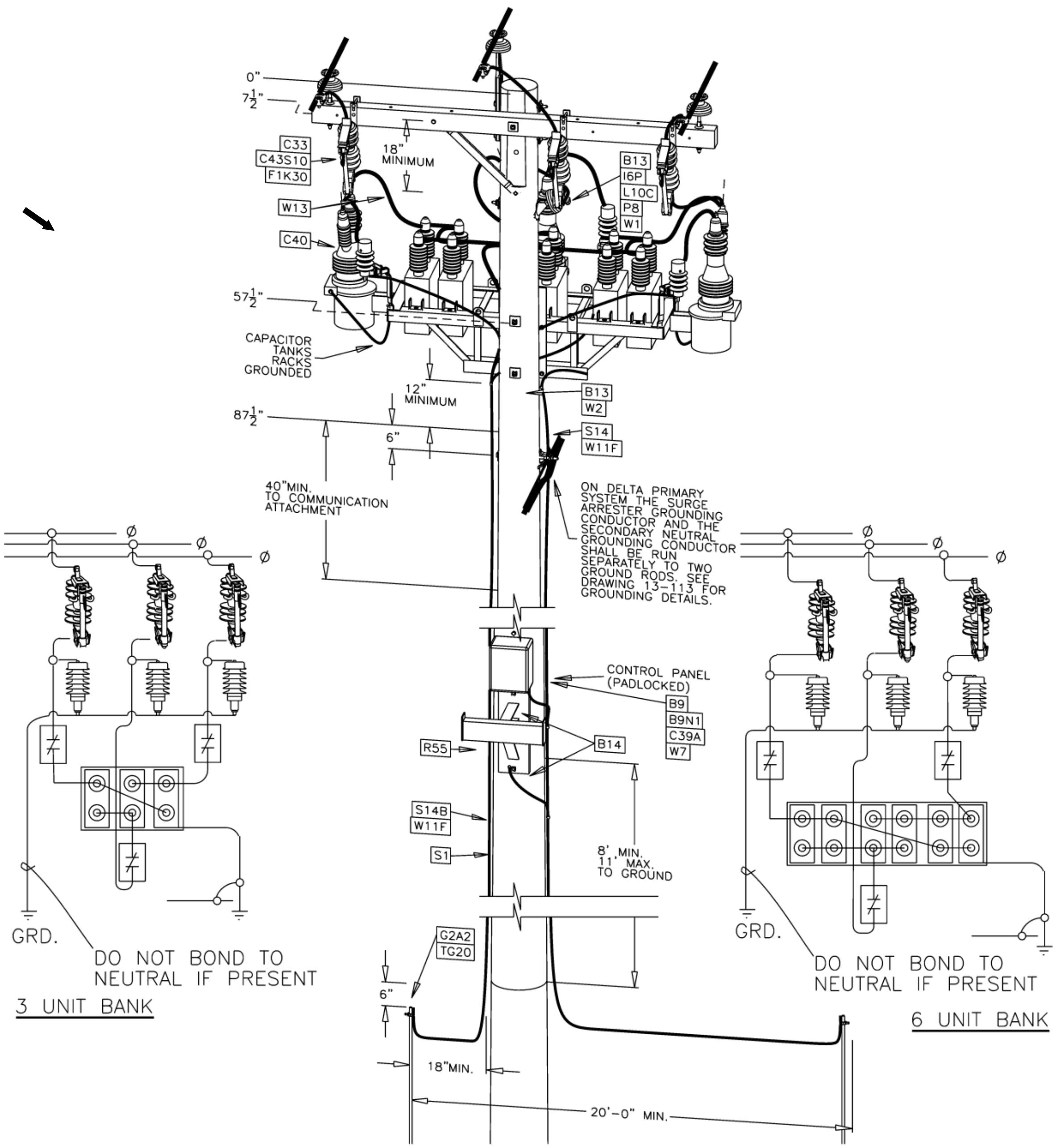


Designer	Drawing	Date
MPR	od15333	5/28/21

3Ø SWITCHED CAPACITOR INSTALLATION EFFECTIVELY GROUNDED 15 kV

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	15-333	7/21

MU = @(E)KBC3(V)DSWNE or DW	(E) = kVAR Size, (V)= Voltage



NOTES:

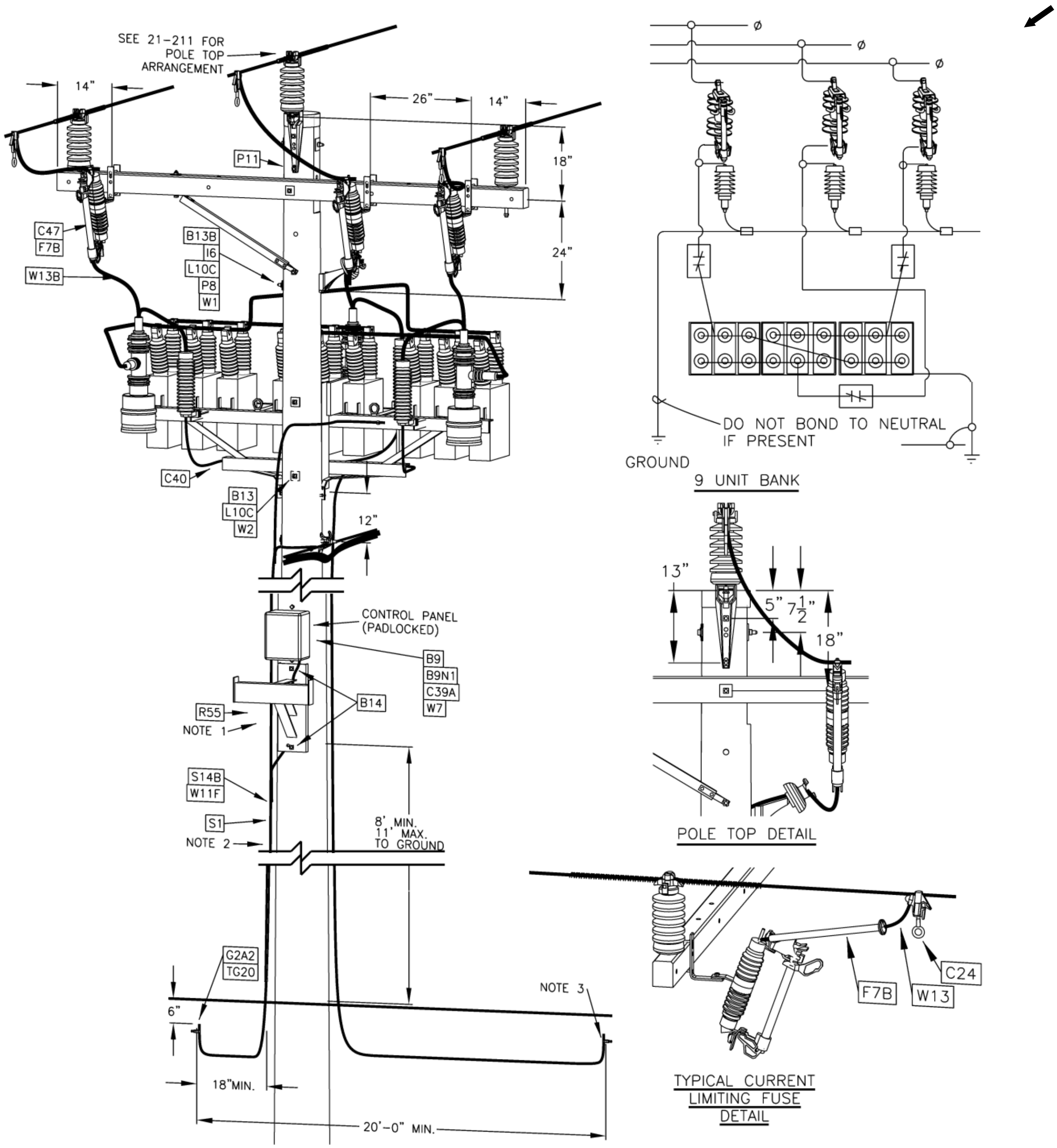
1. LADDER RACK FOR CONTROL CABINET INSTALLATIONS OVER 8' BOND RACK TO DOWN GROUND.
2. CONTROL CABINET, CAPACITOR RACK AND SECONDARY NEUTRAL SHALL BE BONDED AND ATTACHED TO DOWN GROUND. GROUND RESISTANCE TO EARTH SHALL NOT EXCEED 25OHMS. SEE STD 13-111 & 13-113.
3. ARRESTORS SHALL HAVE SEPARATE ISOLATED 20' MIN. FROM OTHER GROUND ROD. GROUND RESISTANCE TO EARTH SHALL NOT EXCEED 25OHMS.

Designer	Drawing	Date
MPR	od15334	5/28/21

Supersedes 7/20 Issue – Update drawing to 3D.

3Ø SWITCHED CAPACITOR INSTALLATION NOT EFFECTIVELY GROUNDED 15 kV

Supersedes 7/20 Issue – Update drawing to 3D



NOTES:

1. LADDER RACK FOR CONTROL CABINET INSTALLATIONS OVER 8' BOND RACK TO DOWN GROUND.
2. CONTROL CABINET AND CAPACITOR RACK SHALL BE BONDED AND ATTACHED TO DOWN GROUND. GROUND RESISTANCE TO EARTH SHALL NOT EXCEED 25OHMS. SEE STD 13-111 & 13-113.
3. ARRESTORS SHALL HAVE SEPARATE ISOLATED 20' MIN. FROM OTHER GROUND ROD. GROUND RESISTANCE TO EARTH SHALL NOT EXCEED 25OHMS.

Designer	Drawing	Date
MPR	od15334A	5/28/21

3Ø SWITCHED CAPACITOR INSTALLATION NOT EFFECTIVELY GROUNDED 23kV			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 15-334A	ISSUE 7/21

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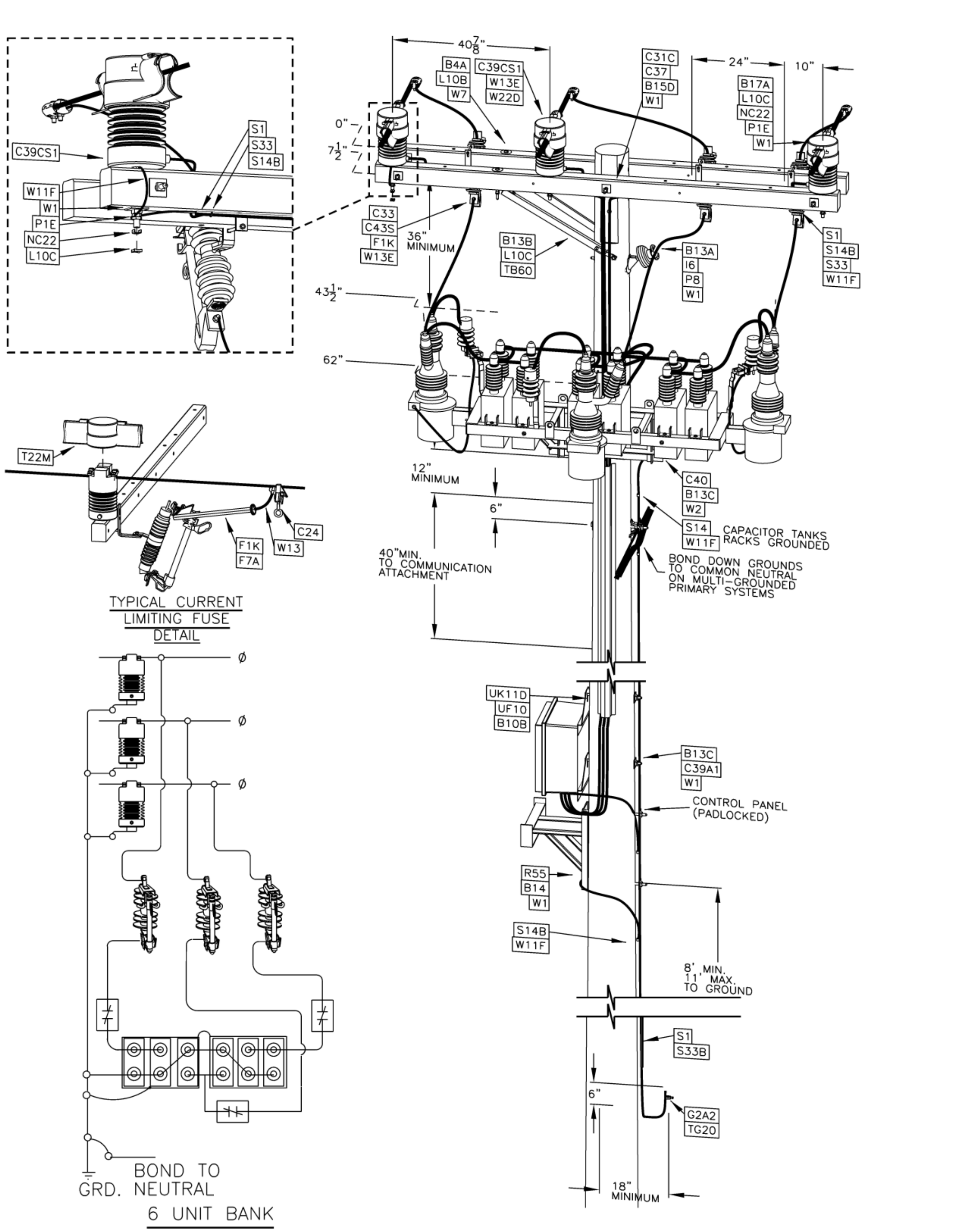
MU = @300K3C2441YSWADVANCED	
MU = @600KB7613YSWADVANCED	MU = @900KB7613YSWADVANCED

Supersedes 7/20 Issue – Update drawing to 3D



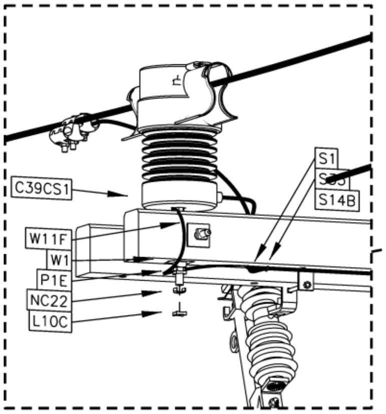
SEE PAGE 15–335A FOR CONSTRUCTION NOTES.

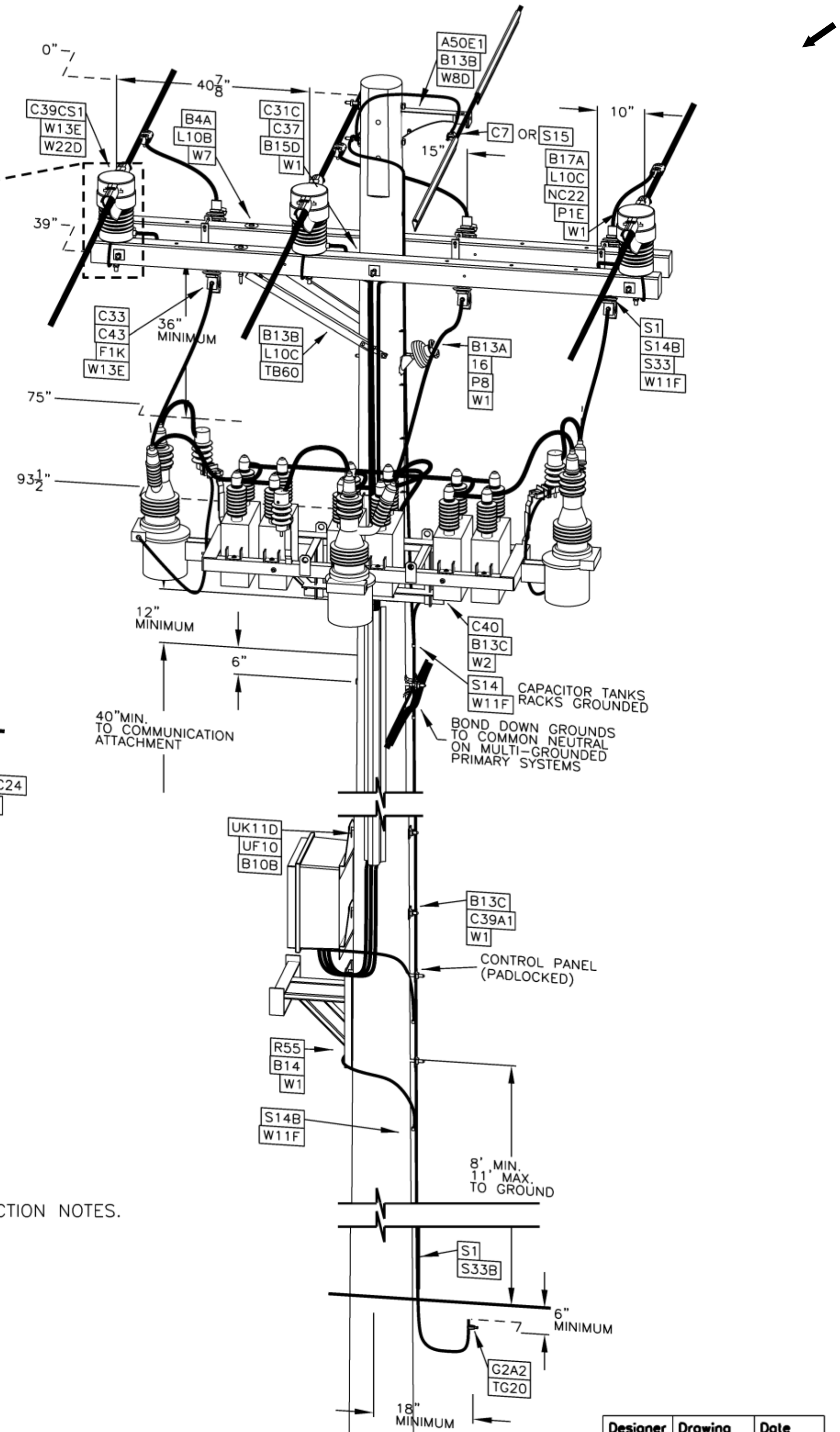
Designer	Drawing	Date
MPR	od15335	5/28/21

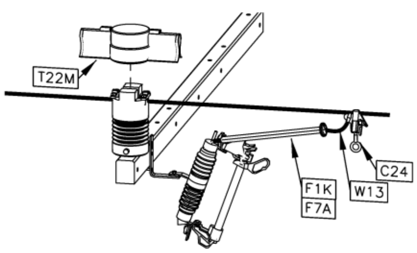
3Ø SWITCHED CAPACITOR INSTALLATION EFFECTIVELY GROUNDED 15kV CLASS AND BELOW WITH CURRENT/VOLTAGE SENSOR

Notes for 15kV class capacitor bank with current/voltage sensor:

1. For available fault current over 5,000 sym, requires a current limiting fuse (Std Item F7A__). If units are 50kVAR and smaller available fault current is reduced to 4,000 sym.
2. Capacitors must be connected to primary on the load side of the current/voltage sensor with the H1 marking on the insulator/sensor facing source.
3. Sensor pin P1F1 or P1G must be grounded prior to any energized phase being placed on the insulator sensor. Ground shall be attached along the underside of the crossarm and down the pole to attach to the ground system. Secure with staples.
4. Covered primary conductor must be striped 2” on each side of sensor.
5. Locate control away from vehicular traffic (field side of pole).
6. See Section 13 for grounding and ground rod installation details.
7. Typical primary pole top construction shown, alternate pole top construction may be needed based on wire size and span.
8. Both ends of U duct STD Item UK11D shall be sealed with expanding foam Std Item UF10
9. Drawing shows an antenna at top of pole for communication, contact UoF (Utility of the Future) for choosing communications means.
10. Control requires secondary power source.
11. Contol cable shall be run in ground covering molding (S1) and stapled on the underside of the cross arm parallel to the ground wire.
12. See section 25 for telecom requirements.
13. Primary phases need to be identified with appropriate testing meter and labeled per section 2.1.30







TYPICAL CURRENT LIMITING FUSE DETAIL

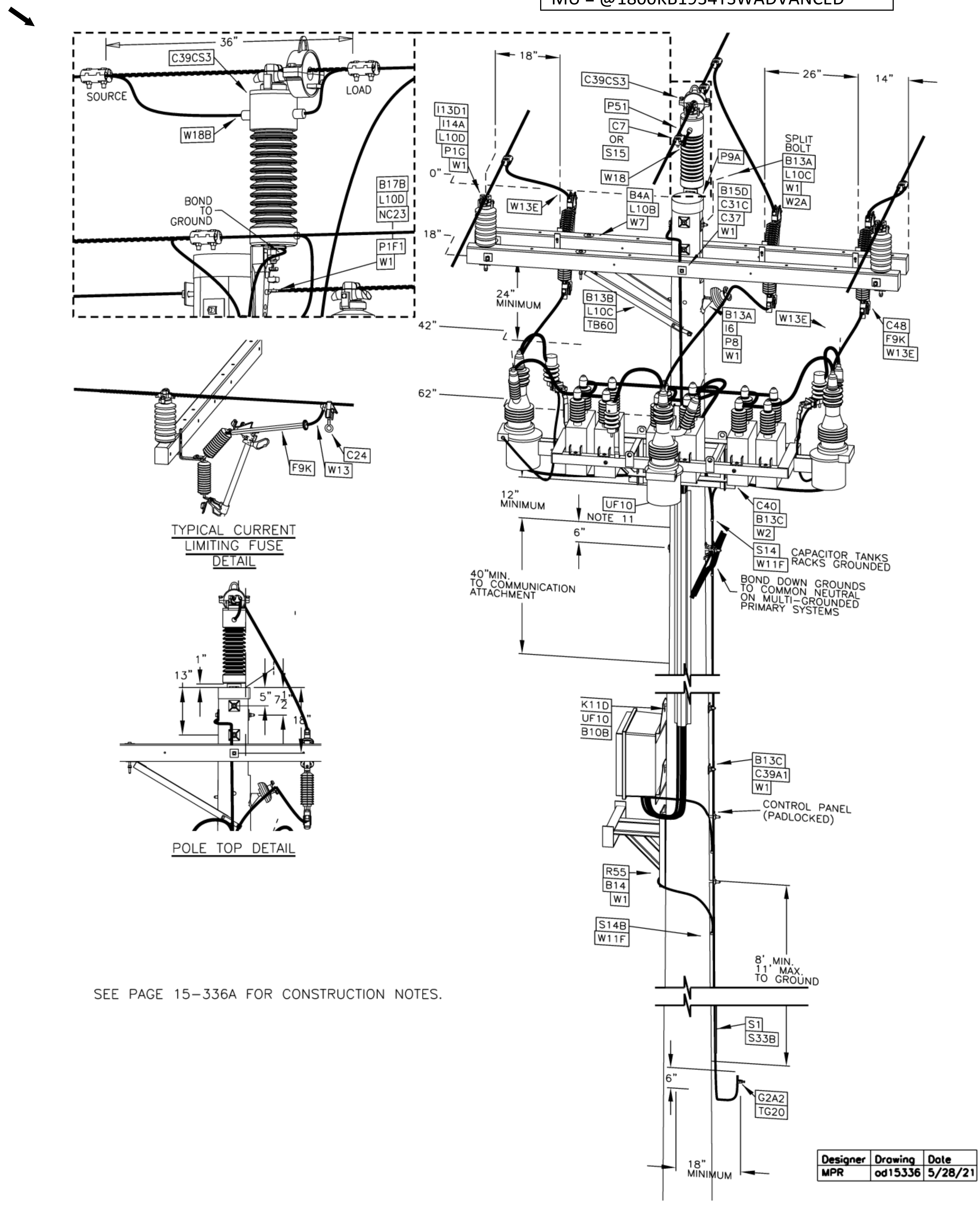
SEE PAGE 15-335A FOR CONSTRUCTION NOTES.

Designer	Drawing	Date
MPR	od15335B	8/23/20

3Ø SWITCHED CAPACITOR INSTALLATION EFFECTIVELY GROUNDED 35kV CLASS AND BELOW WITH CURRENT/VOLTAGE SENSOR SPACER CABLE

MU = @1200K3C1934YSWADVANCED
MU = @1800KB1934YSWADVANCED

Supersedes 7/19 Issue – Update drawing to 3D.



SEE PAGE 15-336A FOR CONSTRUCTION NOTES.

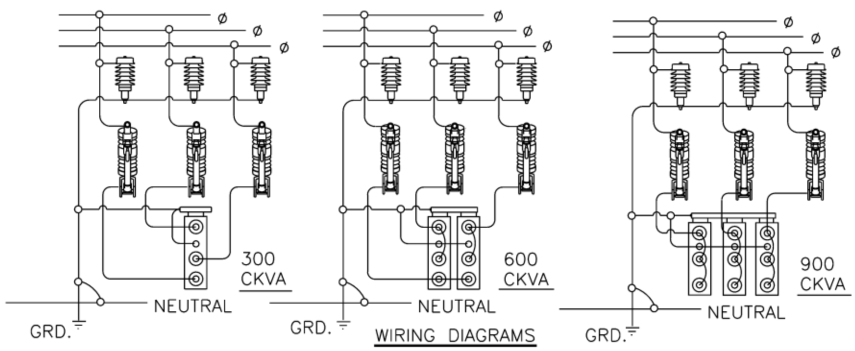
Designer	Drawing	Date
MPR	od15336	5/28/21

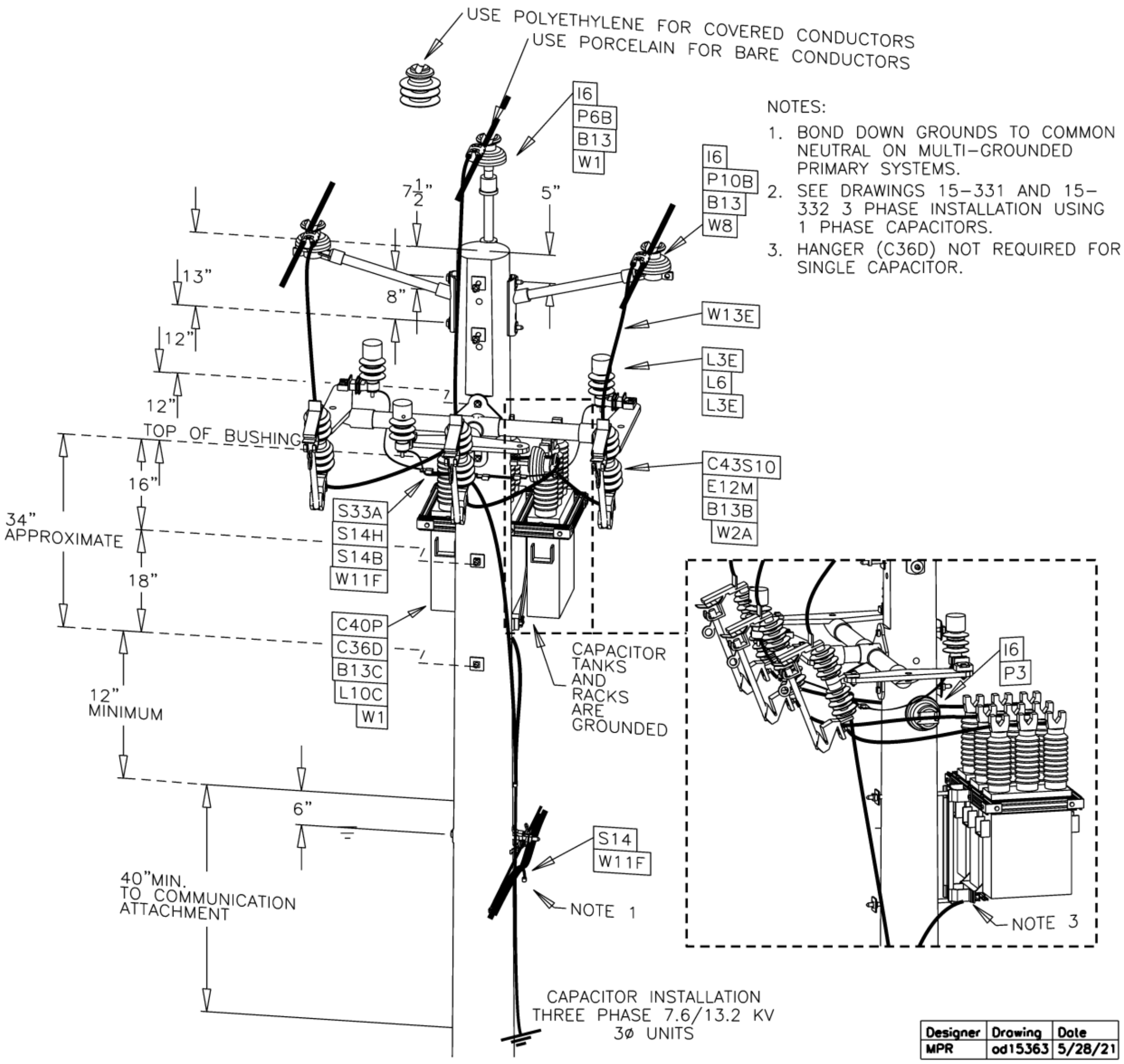
3Ø SWITCHED CAPACITOR INSTALLATION EFFECTIVELY GROUNDED 35kV CLASS AND BELOW WITH CURRENT/VOLTAGE SENSOR

Notes for 35kV class capacitor bank with current/voltage sensor:

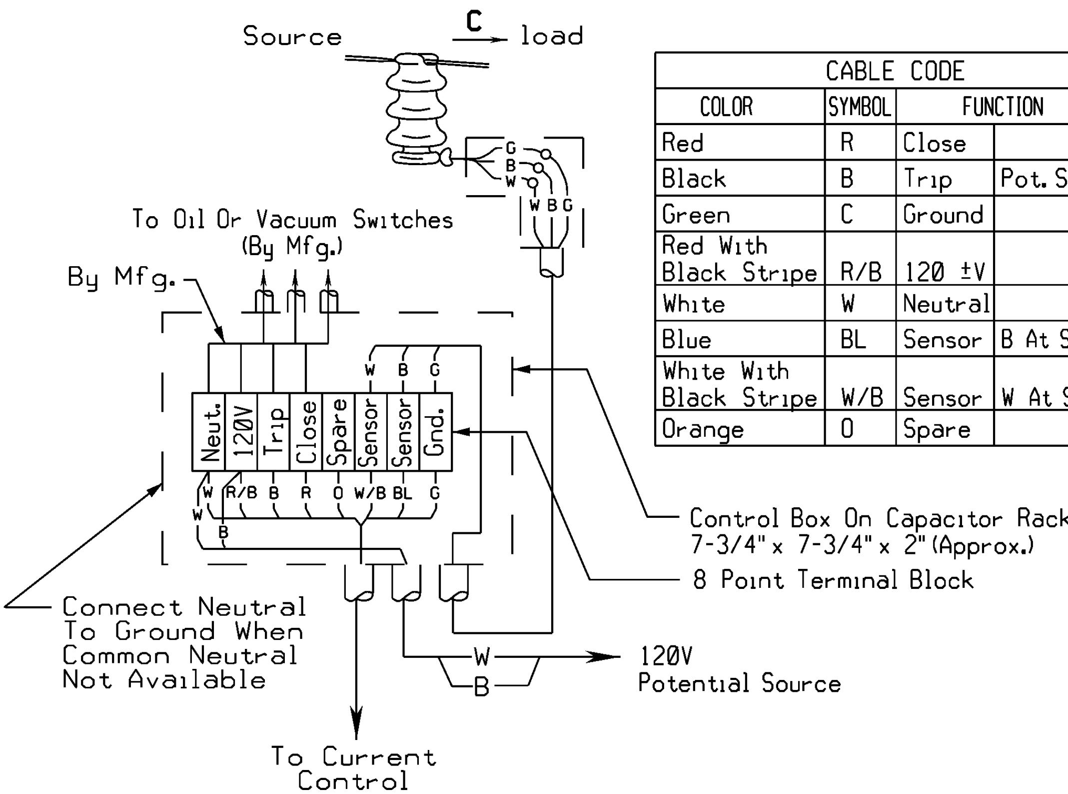
1. For available fault current over 5,000 sym, requires a current limiting fuse (Std Item F7B__).
2. Capacitors must be connected to primary on the load side of the current/voltage sensor with the H1 marking on the insulator/sensor facing source.
3. Sensor pin P1F1 or P1G must be grounded prior to any energized phase being placed on the insulator sensor. Ground shall be attached along the underside of the crossarm and down the pole to attach to the ground system. Secure with staples.
4. Covered primary conductor must be striped 2” on each side of sensor.
5. Locate control away from vehicular traffic (field side of pole).
6. See Section 13 for grounding and ground rod installation details.
7. Typical primary pole top construction shown, alternate pole top construction may be needed based on wire size and span.
8. Trunions used: Aluminum wire must be galvanized trunion, Copper wire must be ductile iron trunion. Trunions are packaged with the sensor.
9. The 4' bare conductor CVMI jumper must be sized for full ampacity of the main line and connected to the main line with Ampacts
10. Choke can not be closed until CVMI jumper is installed.
11. Both ends of U duct STD Item UK11D shall be sealed with expanding foam STD Item UF10.
12. Control requires secondary power source.
13. Sensor may be installed on pole top bracket, P12B or a P1G. Field discretion for ease of installation and maintenance.
14. See section 25 for telecom requirements
15. Primary phases need to be identified with appropriate testing meter and labeled per section 2.1.30

Supersedes 7/10 – Added note 15.

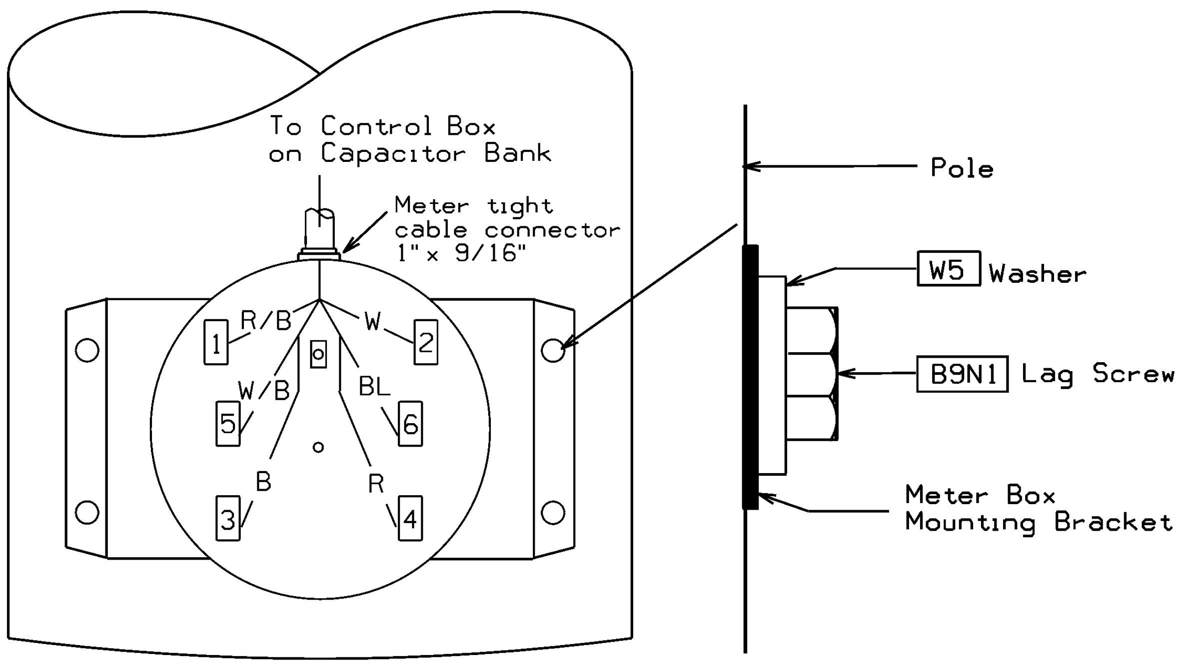

Ø
Ø
Ø
300
CKVA
600
CKVA
900
CKVA
NEUTRAL
GRD.
WIRING DIAGRAMS


USE POLYETHYLENE FOR COVERED CONDUCTORS
USE PORCELAIN FOR BARE CONDUCTORS
I6
P6B
B13
W1
I6
P10B
B13
W8
NOTES:
1. BOND DOWN GROUNDS TO COMMON NEUTRAL ON MULTI-GROUNDED PRIMARY SYSTEMS.
2. SEE DRAWINGS 15-331 AND 15-332 3 PHASE INSTALLATION USING 1 PHASE CAPACITORS.
3. HANGER (C36D) NOT REQUIRED FOR SINGLE CAPACITOR.
7 1/2"
5"
13"
8"
12"
12"
W13E
L3E
L6
L3E
TOP OF BUSHING
C43S10
E12M
B13B
W2A
16"
34"
APPROXIMATE
18"
S33A
S14H
S14B
W11F
C40P
C36D
B13C
L10C
W1
12"
MINIMUM
CAPACITOR
TANKS
AND
RACKS
ARE
GROUNDED
I6
P3
6"
S14
W11F
NOTE 1
NOTE 3
40"MIN.
TO COMMUNICATION
ATTACHMENT
CAPACITOR INSTALLATION
THREE PHASE 7.6/13.2 KV
3Ø UNITS
Designer | Drawing | Date
MPR | od15363 | 5/28/21

Current Control Wiring Diagram



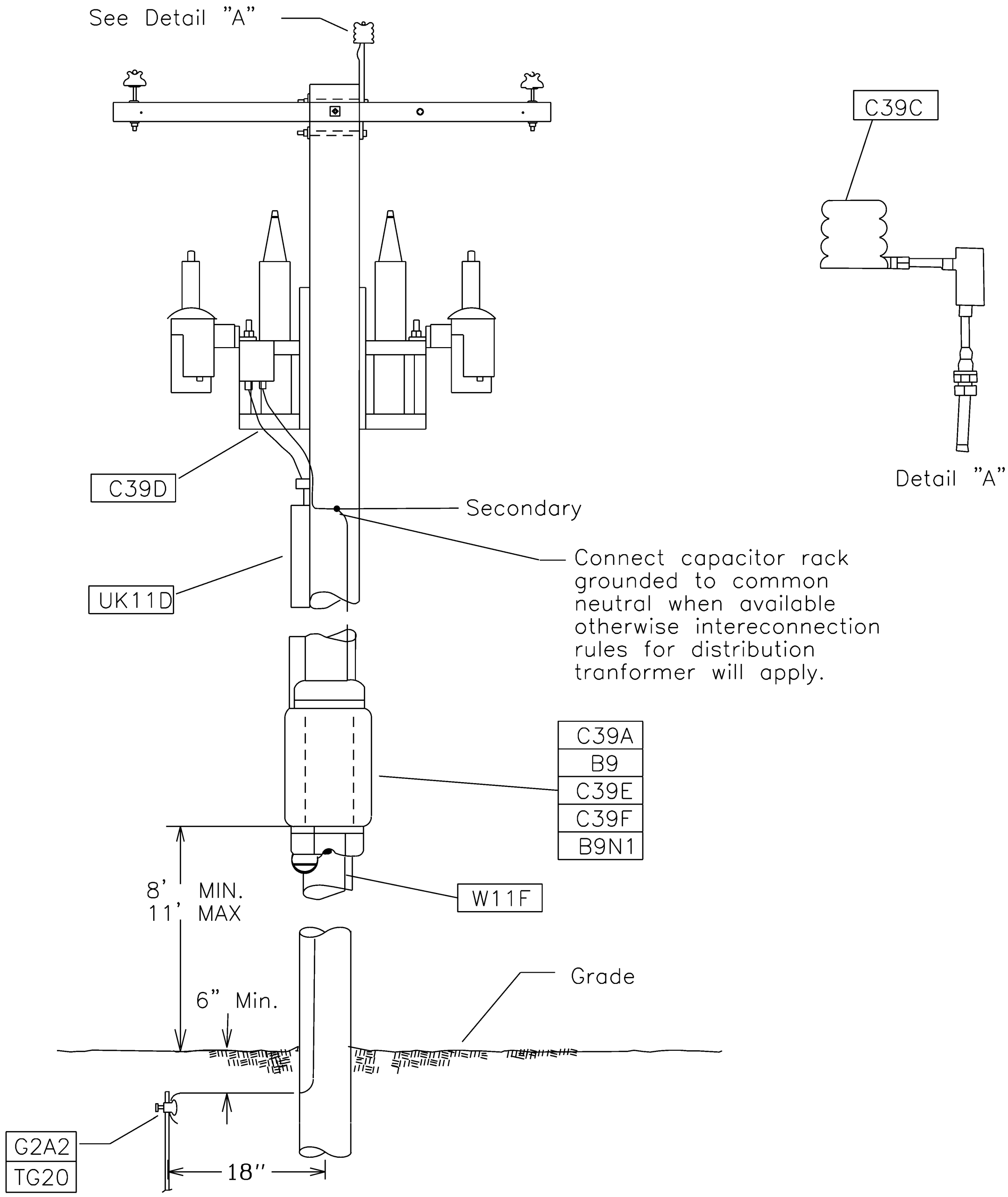
CABLE CODE			
COLOR	SYMBOL	FUNCTION	
Red	R	Close	
Black	B	Trip	Pot. Source
Green	C	Ground	
Red With Black Stripe	R/B	120 ±V	
White	W	Neutral	
Blue	BL	Sensor	B At Sensor
White With Black Stripe	W/B	Sensor	W At Sensor
Orange	O	Spare	



Supersedes 7/10 – Revised meter socket wire labels.

SWITCHED CAPACITOR CURRENT CONTROL WIRING DIAGRAM 6 PIN METER SOCKET

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	15-399	7/10



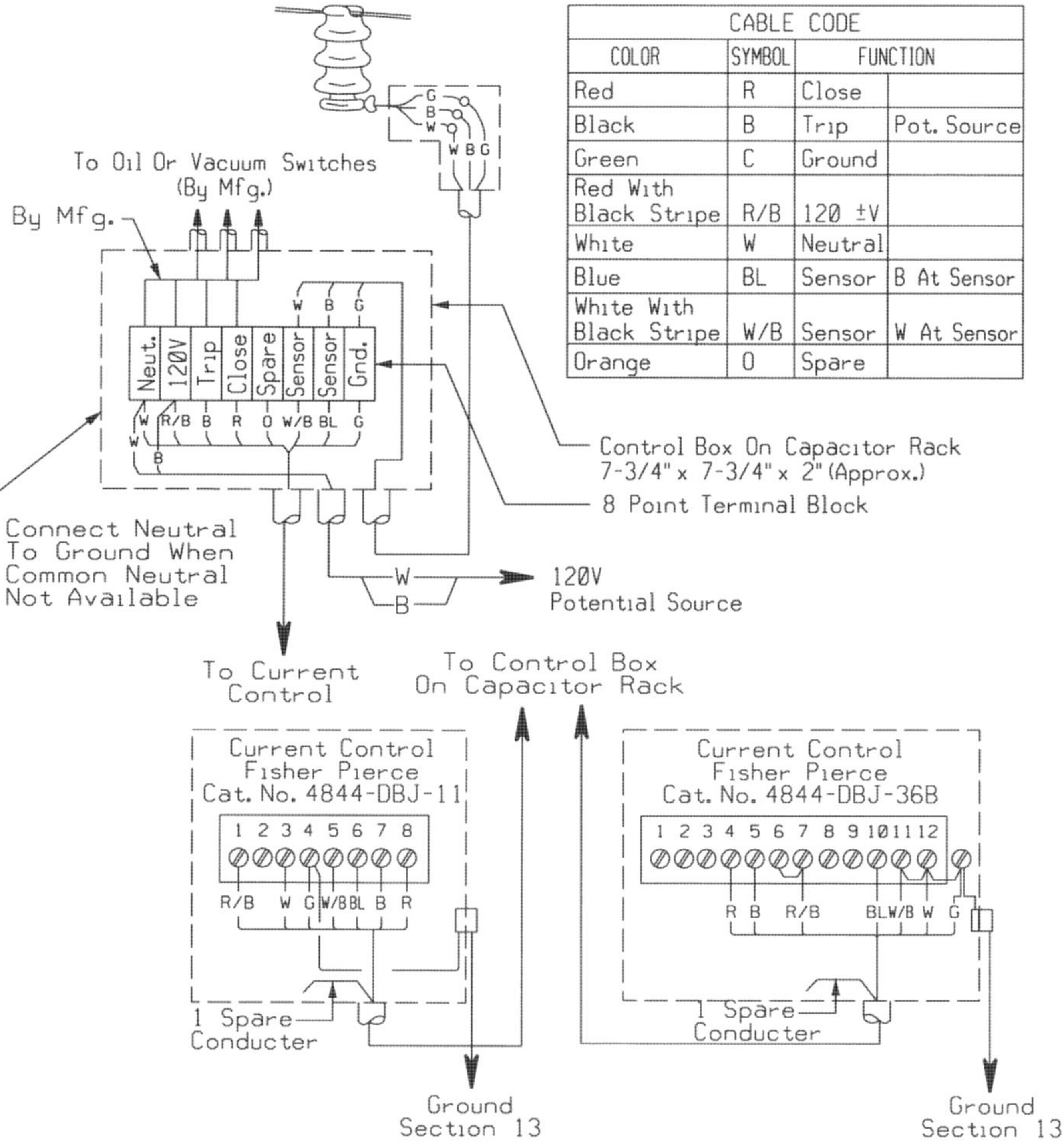
NOTES:

1. LOCATE INSTALLATION AWAY FROM VEHICULAR TRAFFIC.
2. CAPACITORS TO BE CONNECTED TO PRIMARY ON STATION SIDE OF CURRENT SENSOR.
3. CURRENT SENSOR SHOULD ALWAYS BE LOCATED ON RIDGE PIN OR ON PHASE CONDUCTOR NEAREST THE POLE.
4. PHASE CONDUCTOR MUST BE IN CENTER GROOVE OF THE SENSOR.
5. SEE SECTION 13 FOR GROUNDING AND GROUND ROD INSTALLATION DETAILS.
6. BOTH ENDS OF U DUCT STD ITEM UK11D SHALL BE SEALED WITH EXPANDING FOAM STD ITEM UF10
7. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od15400	6/30/20

Current Control Wiring Diagram

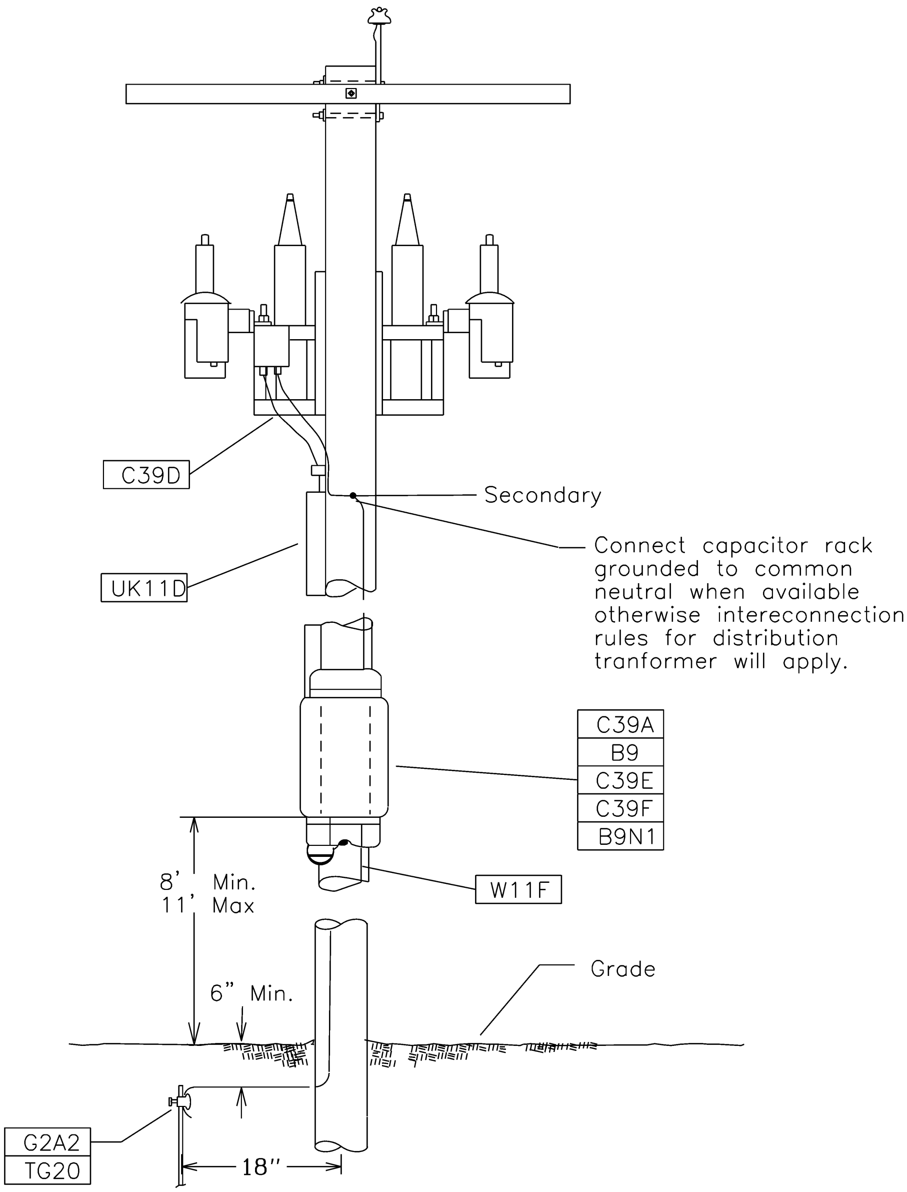
CABLE CODE			
COLOR	SYMBOL	FUNCTION	
Red	R	Close	
Black	B	Trip	Pot. Source
Green	C	Ground	
Red With Black Stripe	R/B	120 ±V	
White	W	Neutral	
Blue	BL	Sensor	B At Sensor
White With Black Stripe	W/B	Sensor	W At Sensor
Orange	O	Spare	



Supersedes 7/10 Issue – Added note

SWITCHED CAPACITOR CURRENT CONTROL WIRING DIAGRAM HARD WIRE

Supersedes 7/10 Issue – Added note 2.

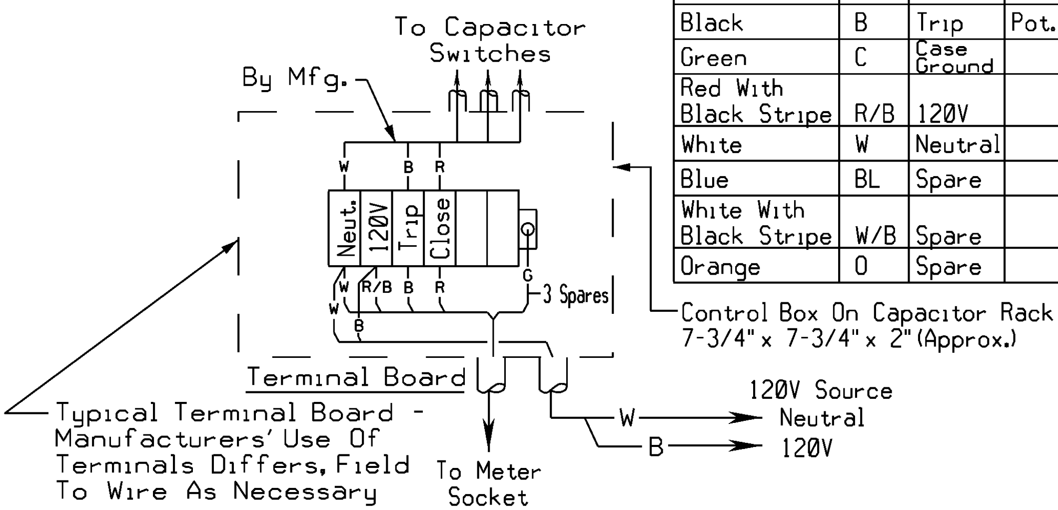


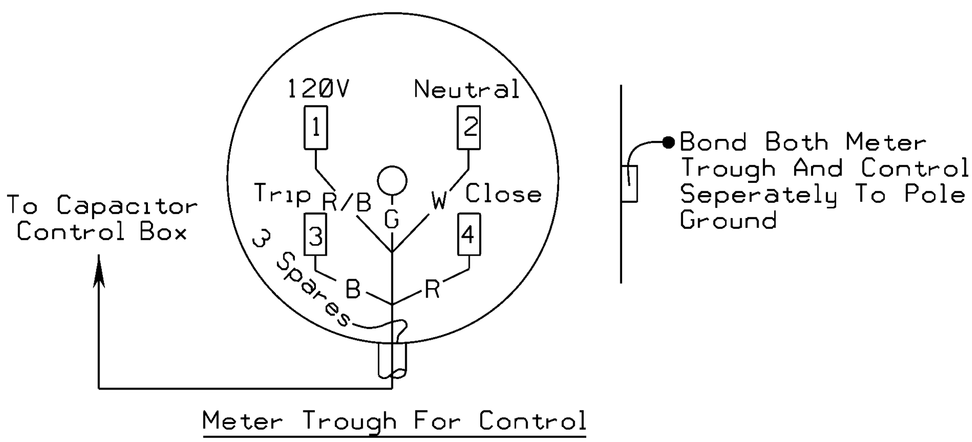
Note:

1. SEE SECTION 13 FOR GROUNDING AND GROUND ROD INSTALLATION DETAILS.
2. BOTH ENDS OF U DUCT STD ITEM UK11D SHALL BE SEALED WITH EXPANDING FOAM STD ITEM UF10
3. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

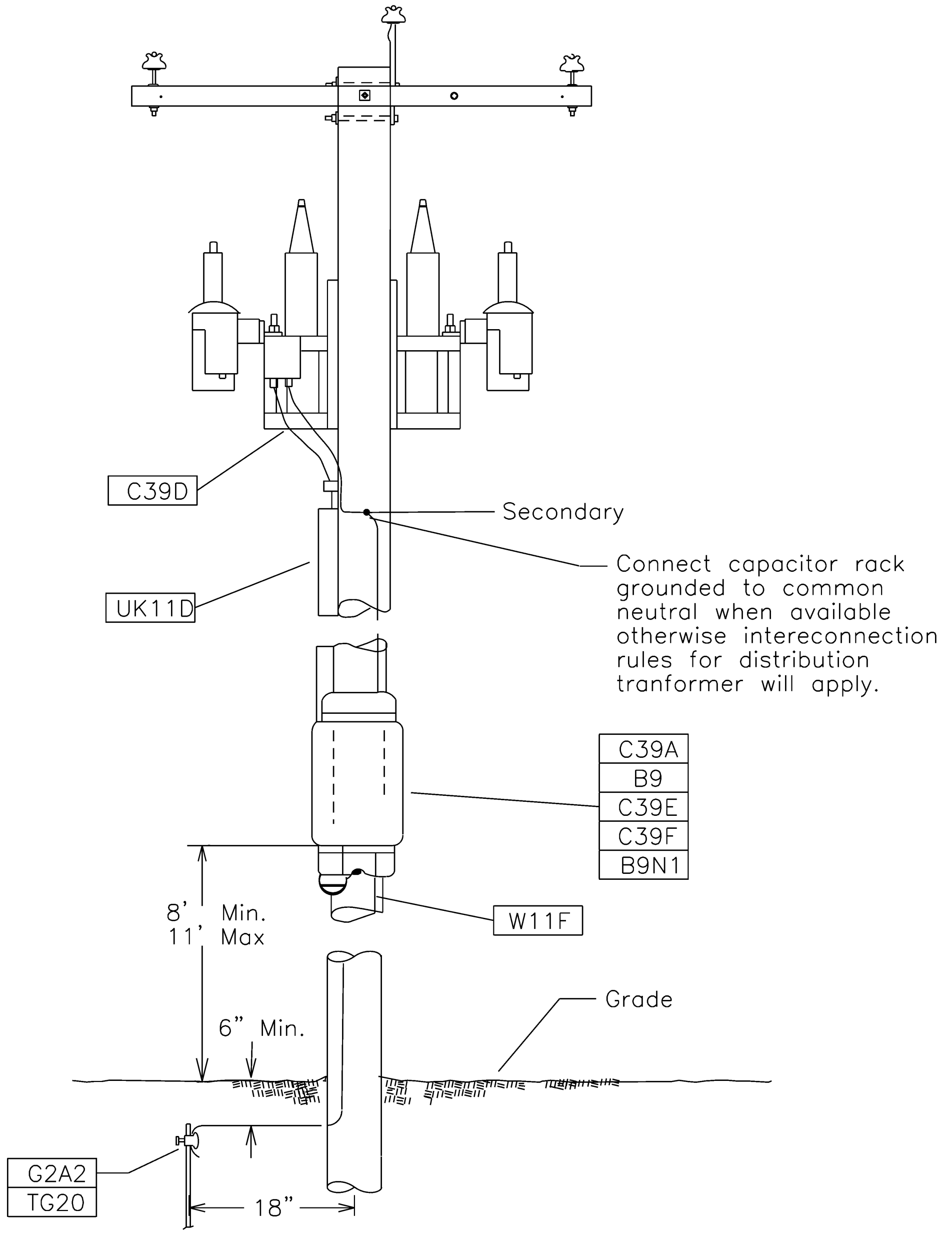
Designer	Drawing	Date
MPR	od15402	6/30/20

Control Cable Code			
Color	Symbol	Function	
Red	R	Close	
Black	B	Trip	Pot. Source
Green	C	Case Ground	
Red With Black Stripe	R/B	120V	
White	W	Neutral	
Blue	BL	Spare	
White With Black Stripe	W/B	Spare	
Orange	O	Spare	





Supersedes 1/06 - Spelling error correction



Note:

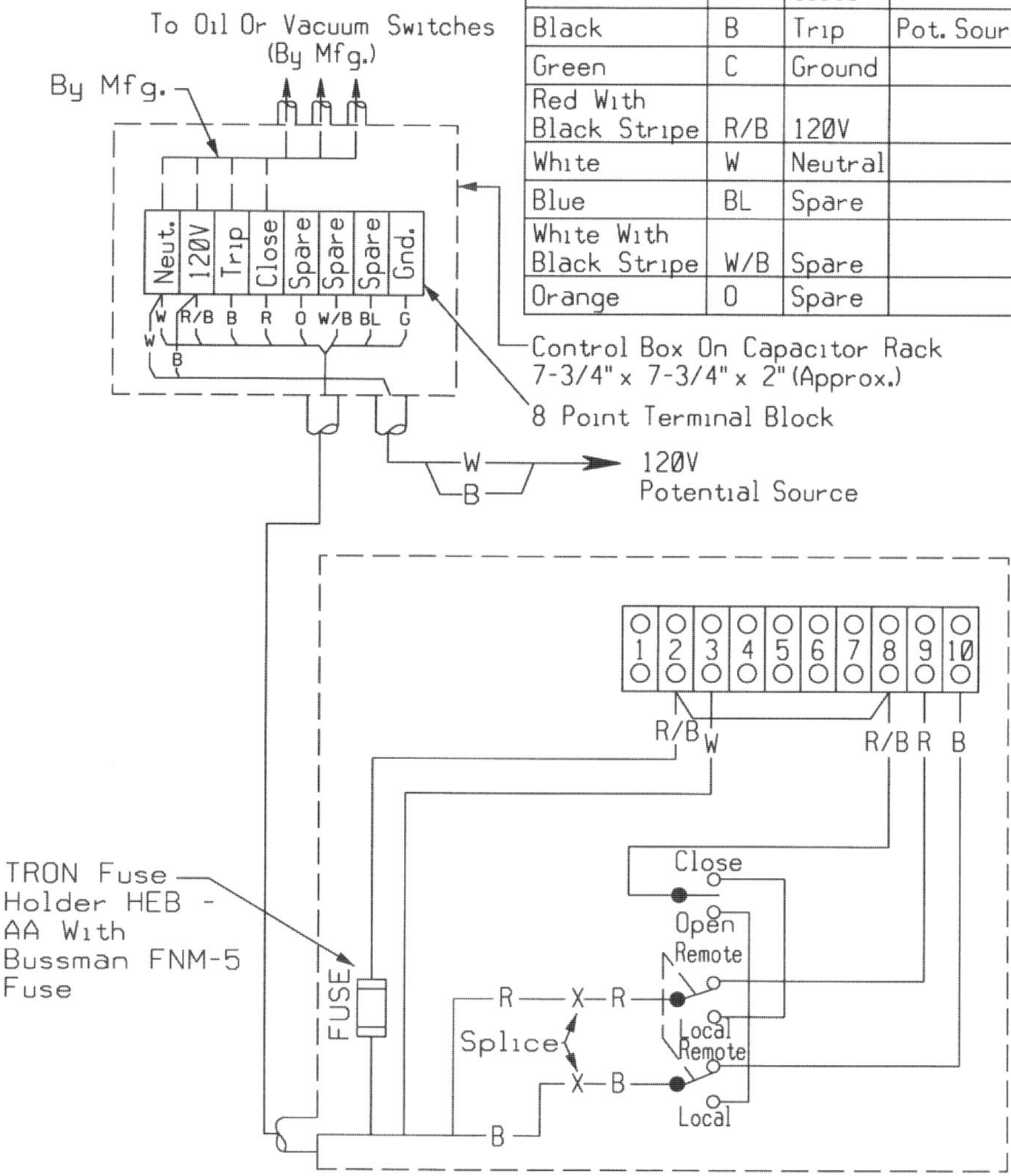
1. BOTH ENDS OF U DUCT STD ITEM UK11D SHALL BE SEALED WITH EXPANDING FOAM STD ITEM UF10
2. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od15404	6/30/20

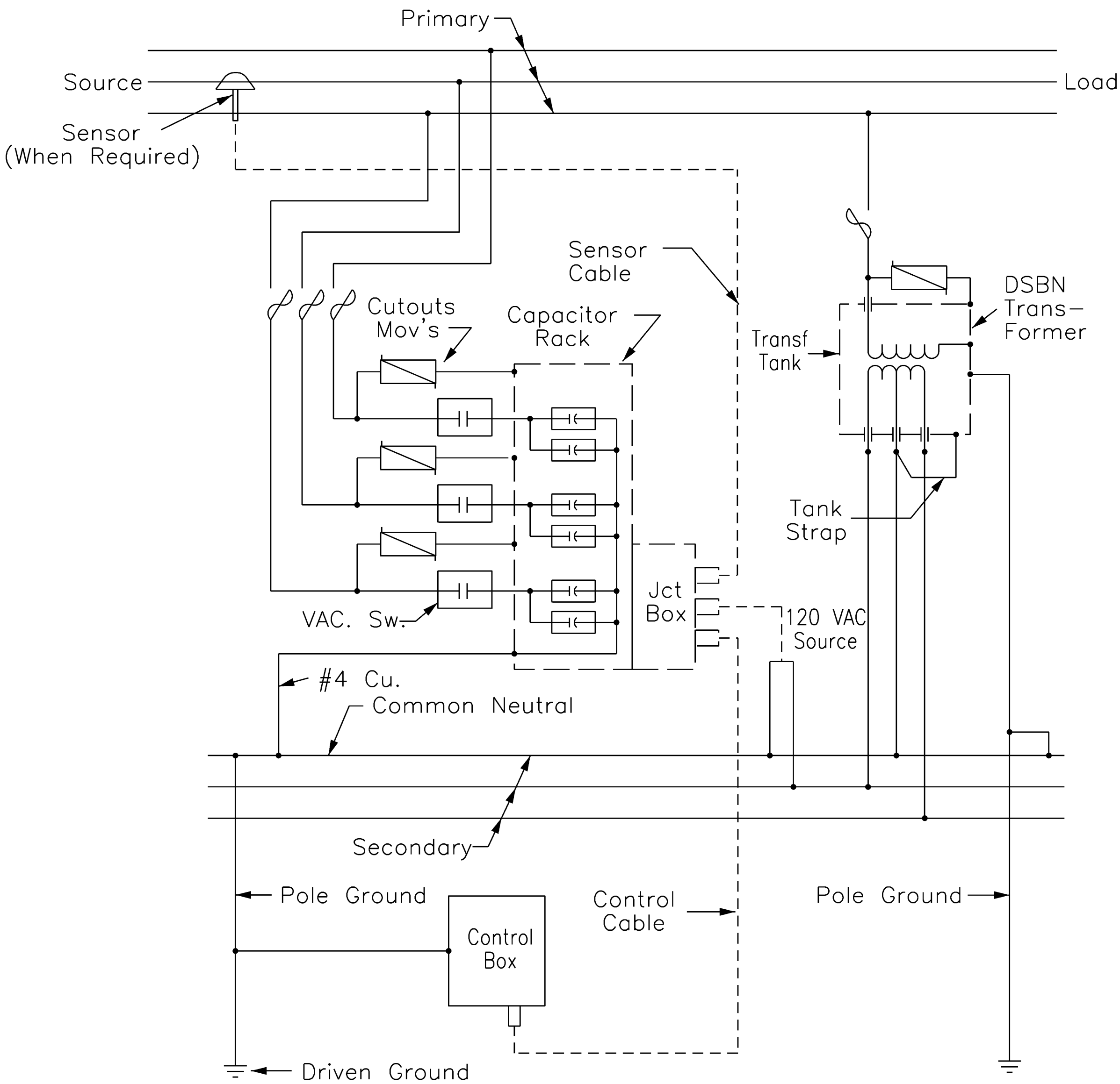
Supersedes 7/10 Issue – Added Note.

3Ø SWITCHED CAPACITOR RADIO CONTROL INSTALLATION 15KV

CABLE CODE			
COLOR	SYMBOL	FUNCTION	
Red	R	Close	
Black	B	Trip	Pot. Source
Green	C	Ground	
Red With Black Stripe	R/B	120V	
White	W	Neutral	
Blue	BL	Spare	
White With Black Stripe	W/B	Spare	
Orange	O	Spare	

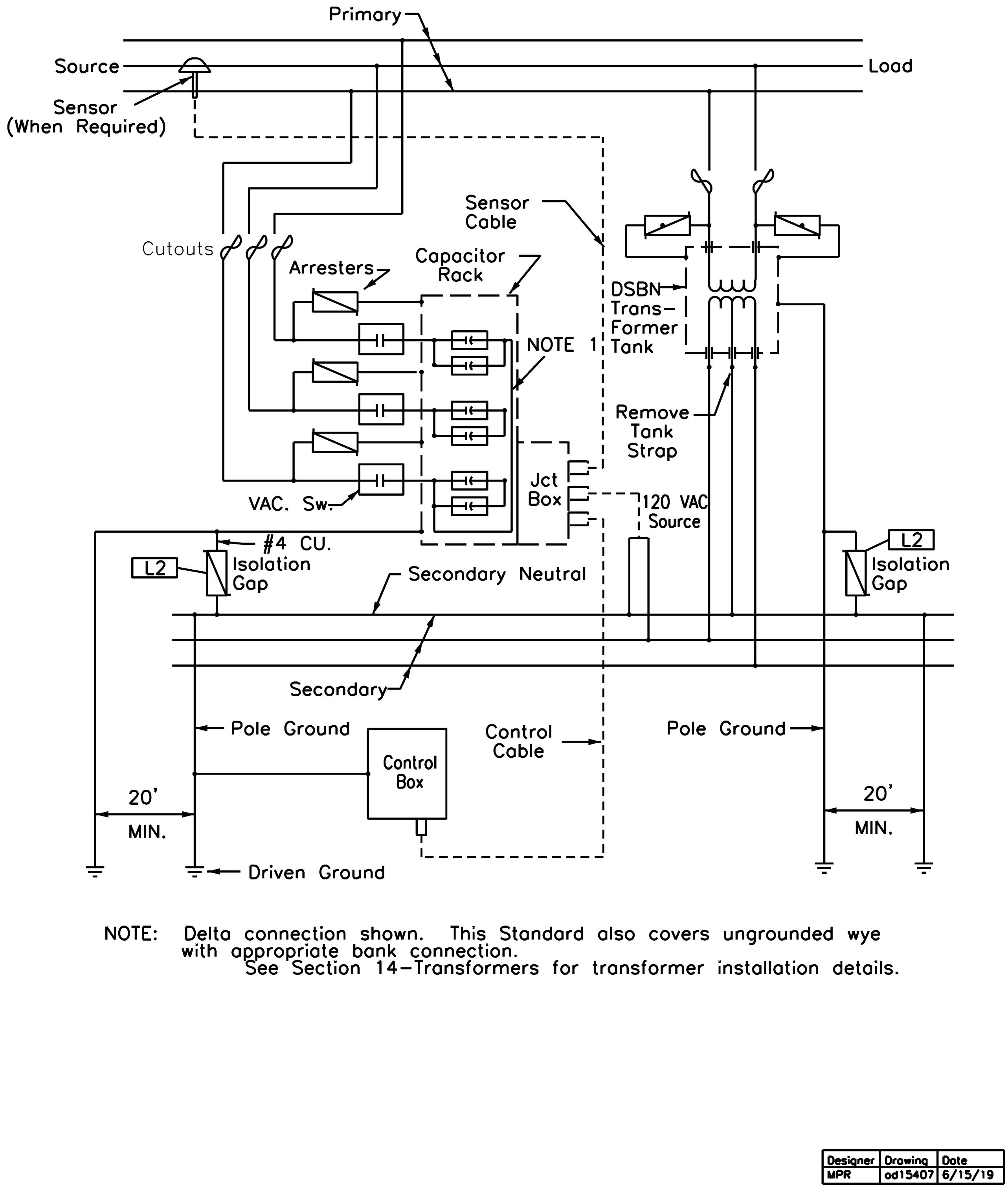


RADIO CONTROL WIRING DIAGRAM



Designer	Drawing	Date
MPR	od15406	6/15/19

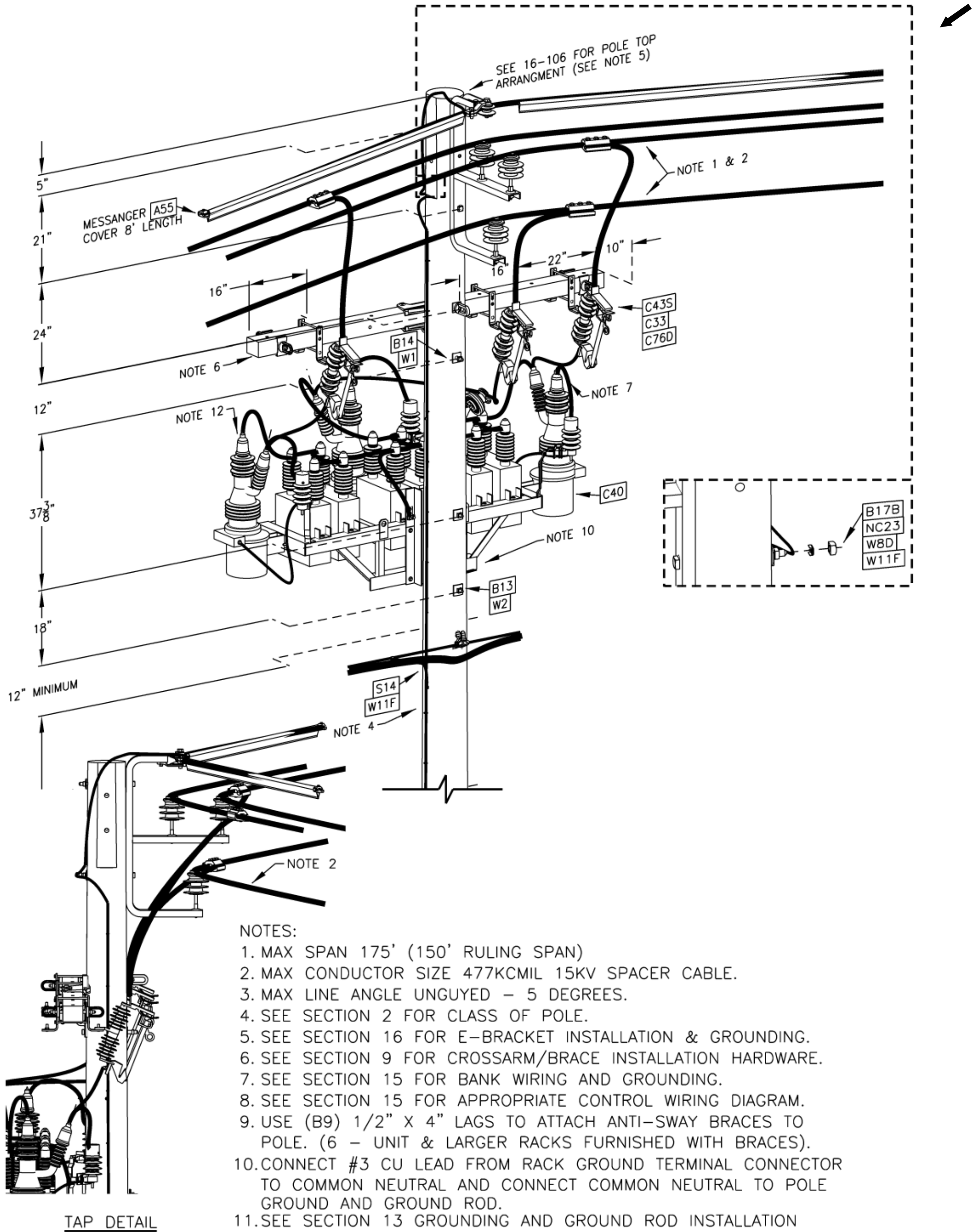
COMMON NEUTRAL WIRING SWITCHED CAPACITOR INSTALLATION DIAGRAM



Supersedes 7/09 Issue -Added note 2.

Note: 1 Delta connection shown. This Standard also covers ungrounded wye with appropriate bank connection. See Section 14-Transformers for transformer installation details.
2. Std Item L2 isolation gap is rated for up to 11 kV, do not install on electric systems greater then 11kV.

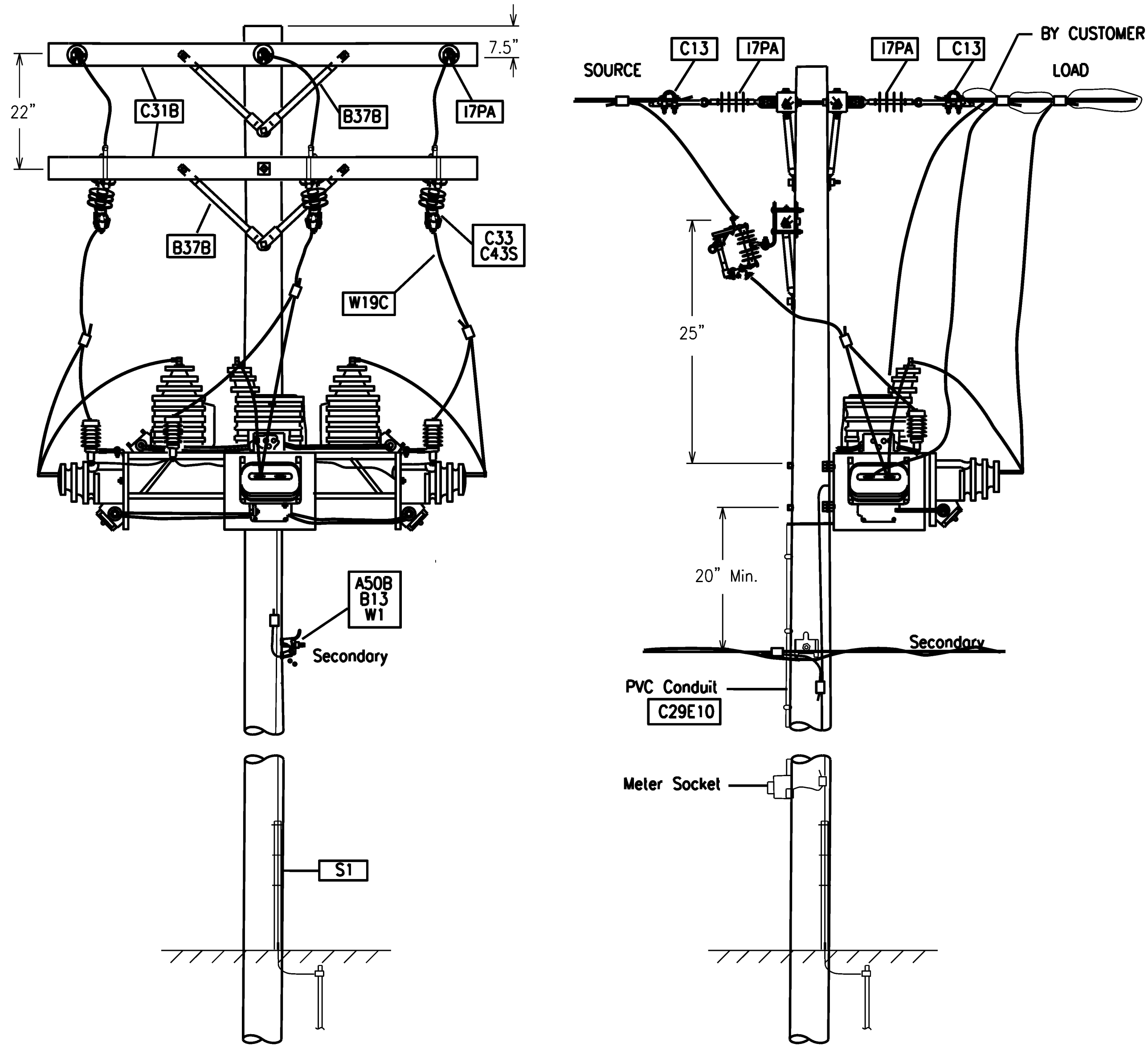
Supersedes 7/12 Issue – Update drawing to 3D.



NOTES:

1. MAX SPAN 175' (150' RULING SPAN)
2. MAX CONDUCTOR SIZE 477KCMIL 15KV SPACER CABLE.
3. MAX LINE ANGLE UNGUYED – 5 DEGREES.
4. SEE SECTION 2 FOR CLASS OF POLE.
5. SEE SECTION 16 FOR E-BRACKET INSTALLATION & GROUNDING.
6. SEE SECTION 9 FOR CROSSARM/BRACE INSTALLATION HARDWARE.
7. SEE SECTION 15 FOR BANK WIRING AND GROUNDING.
8. SEE SECTION 15 FOR APPROPRIATE CONTROL WIRING DIAGRAM.
9. USE (B9) 1/2" X 4" LAGS TO ATTACH ANTI-SWAY BRACES TO POLE. (6 – UNIT & LARGER RACKS FURNISHED WITH BRACES).
10. CONNECT #3 CU LEAD FROM RACK GROUND TERMINAL CONNECTOR TO COMMON NEUTRAL AND CONNECT COMMON NEUTRAL TO POLE GROUND AND GROUND ROD.
11. SEE SECTION 13 GROUNDING AND GROUND ROD INSTALLATION DETAILS.
12. CAPACITOR BANK WIRING SHOULD HAVE HEAT SHRINK WILD LIFE PROTECTION.

Designer	Drawing	Date
MPR	od15409	5/28/21

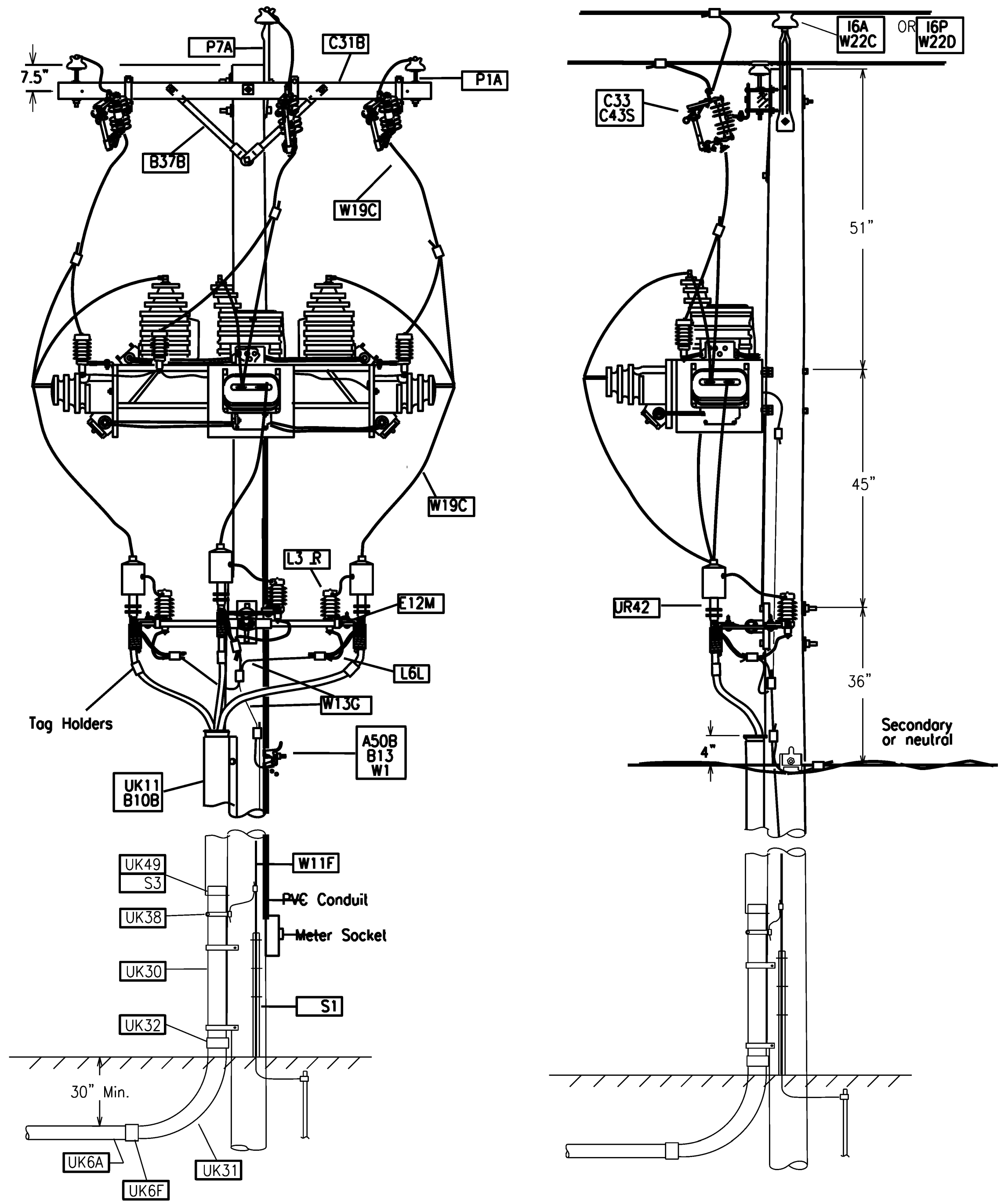


Supersedes 7/13 Issue – Added Grounding Grid and notes 3 and 4.

NOTES:

1. METERING EQUIPMENT SHALL BE SPECIFIED BY METER ENGINEERING.
2. METER SOCKET HEIGHT IS TO BE NO LESS THAN 3 FEET AND NO MORE THAN 6 FEET FROM GROUND TO CENTER OF METER UNLESS OTHERWISE SPECIFIED BY METER ENGINEERING.
3. A GROUND GRID SHALL BE INSTALLED DIRECTLY BENEATH THE METER SOCKET (SEE STANDARDS 13-113 AND 13-114).
4. FOR ALL INSTALLATIONS INCLUDING DISTRIBUTED GENERATION, THE SOURCE OR LINE PRIMARY TAPS ARE CONNECTED TO THE UTILITY. THE LOAD PRIMARY TAPS ARE CONNECTED TO THE CUSTOMER.
5. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od15500	6/30/20



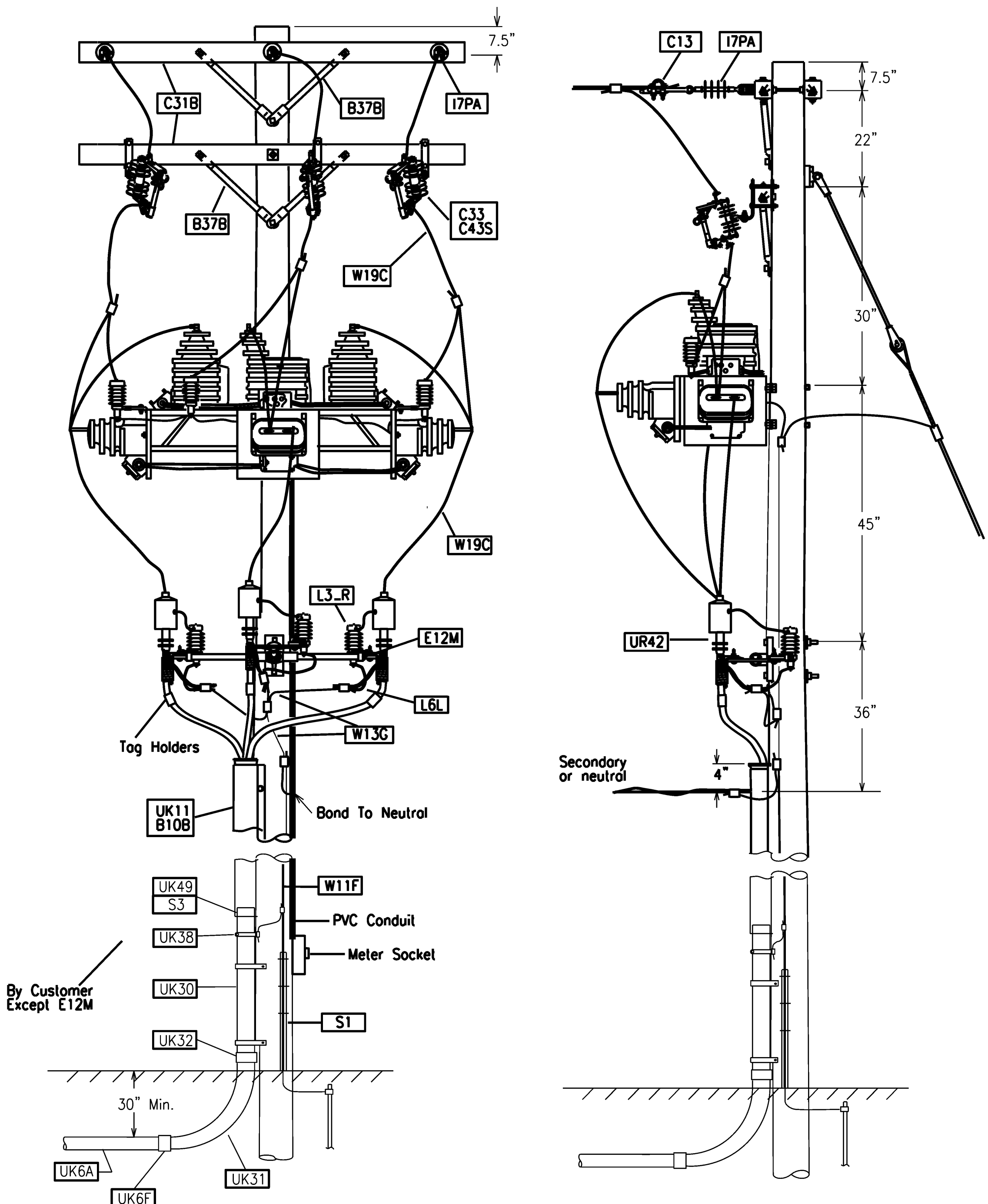
Supersedes 7/10 Issue - Added Ground Grid and Notes 4 & 5.

NOTES:

1. METERING EQUIPMENT SHALL BE SPECIFIED BY METER ENGINEERING.
2. METER SOCKET HEIGHT IS TO BE NO LESS THAN 3 FEET AND NO MORE THAN 6 FEET FROM GROUND TO CENTER OF METER UNLESS OTHERWISE SPECIFIED BY METER ENGINEERING.
3. FOR UG CABLES LARGER THAN #2, W17G SHALL BE USED INSTEAD OF W13G FOR CONCENTRIC CONNECTIONS.
4. A GROUND GRID SHALL BE INSTALLED DIRECTLY BENEATH THE METER SOCKET (SEE STANDARDS 13-113 AND 13-114).
5. FOR ALL INSTALLATIONS INCLUDING DISTRIBUTED GENERATION, THE SOURCE OR LINE PRIMARY TAPS ARE CONNECTED TO THE UTILITY. THE LOAD PRIMARY TAPS ARE CONNECTED TO THE CUSTOMER.
6. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od15501	6/30/20

3Ø PRIMARY METERING – FUSED RISER POLE, TANGENT



NOTES:

1. METERING EQUIPMENT SHALL BE SPECIFIED BY METER ENGINEERING.
2. METER SOCKET HEIGHT IS TO BE NO LESS THAN 3 FEET AND NO MORE THAN 6 FEET FROM GROUND TO CENTER OF METER UNLESS OTHERWISE SPECIFIED BY METER ENGINEERING.
3. FOR UG CABLES LARGER THAN #2, W17G SHALL BE USED INSTEAD OF W13G FOR CONCENTRIC CONNECTIONS.
4. A GROUND GRID SHALL BE INSTALLED DIRECTLY BENEATH THE METER SOCKET (SEE STANDARDS 13-113 AND 13-114).
5. FOR ALL INSTALLATIONS INCLUDING DISTRIBUTED GENERATION, THE SOURCE OR LINE PRIMARY TAPS ARE CONNECTED TO THE UTILITY. THE LOAD PRIMARY TAPS ARE CONNECTED TO THE CUSTOMER.
6. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

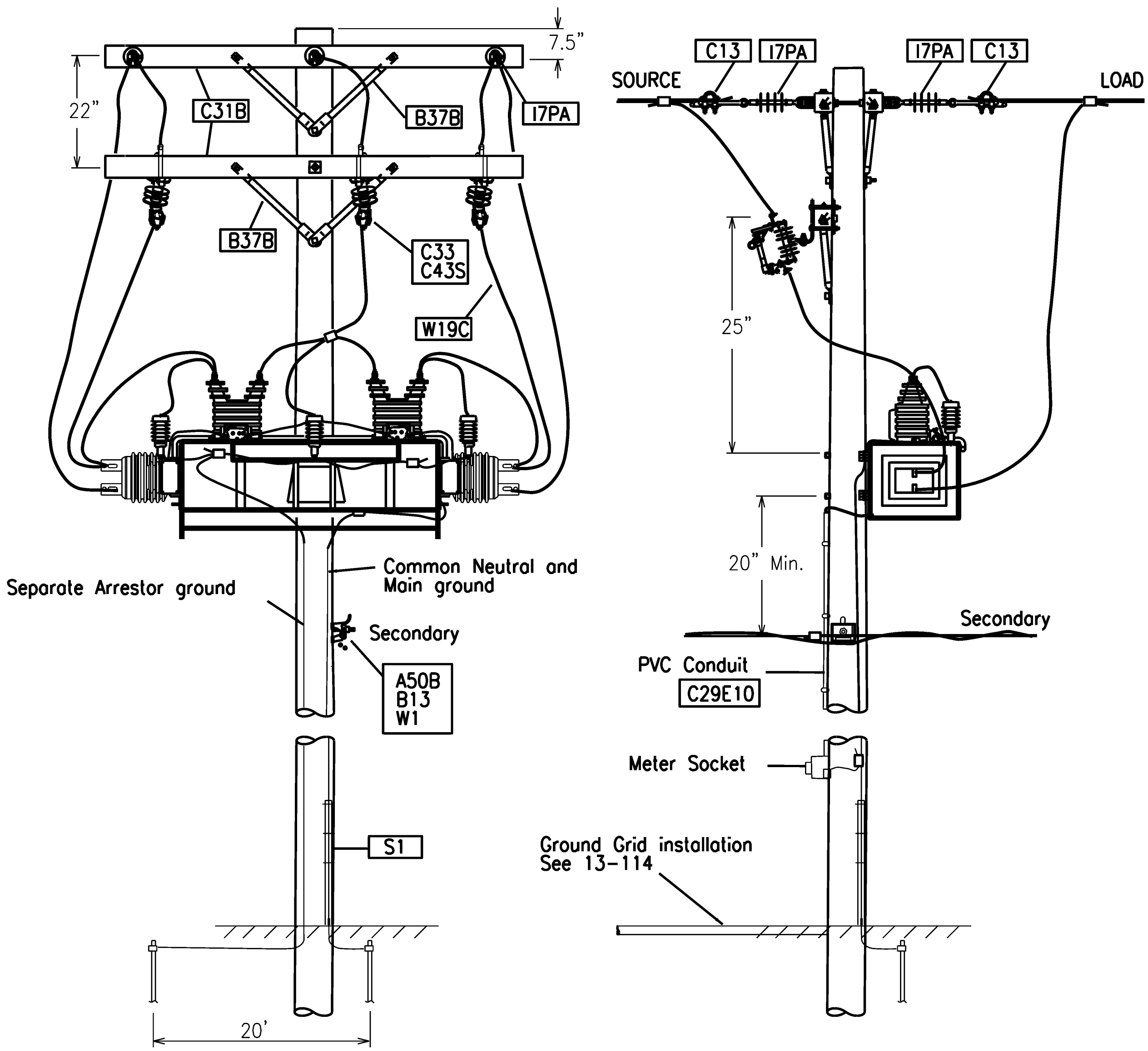
Designer	Drawing	Date
MPR	od15502	6/30/20

Supersedes 07/14 Issue – Updated drawing title.

3Φ PRIMARY METERING – FUSED DEADEND RISER POLE

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	15-502	7/19

7/14 - New Drawing

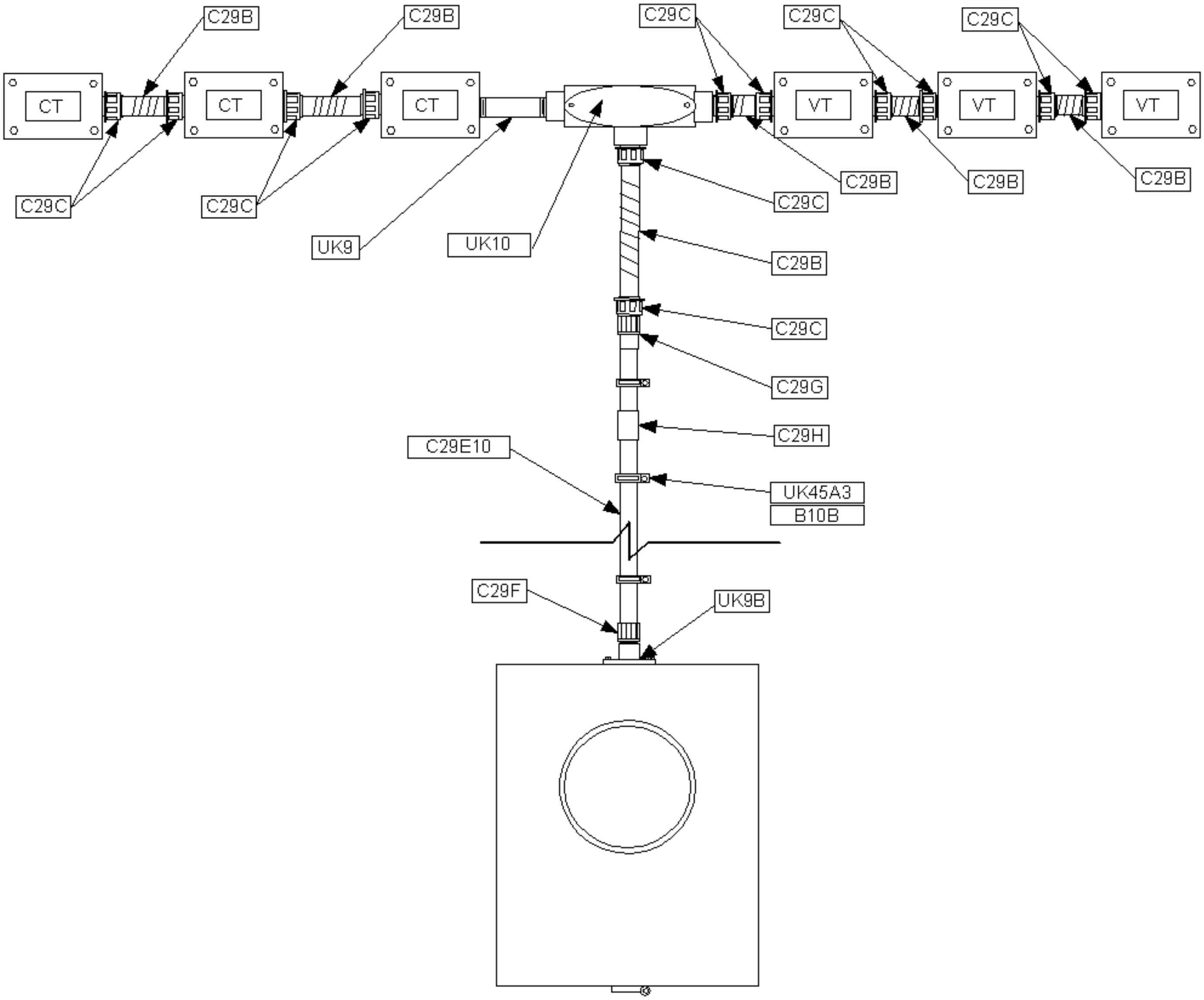


NOTES:
1. METERING EQUIPMENT SHALL BE SPECIFIED BY METER ENGINEERING.
2. METER SOCKET HEIGHT IS TO BE NO LESS THAN 3 FEET AND NO MORE THAN 6 FEET FROM GROUND TO CENTER OF METER UNLESS OTHERWISE SPECIFIED BY METER ENGINEERING.
3. A GROUND GRID SHALL BE INSTALLED DIRECTLY BENEATH THE METER SOCKET (SEE STANDARDS 13-113 AND 13-114).
4. FOR ALL INSTALLATIONS INCLUDING DISTRIBUTED GENERATION, THE SOURCE OR LINE PRIMARY TAPS ARE CONNECTED TO THE UTILITY. THE LOAD PRIMARY TAPS ARE CONNECTED TO THE CUSTOMER.
5. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od15503	6/30/20

3Ø PRIMARY METERING – DELTA CIRCUITS

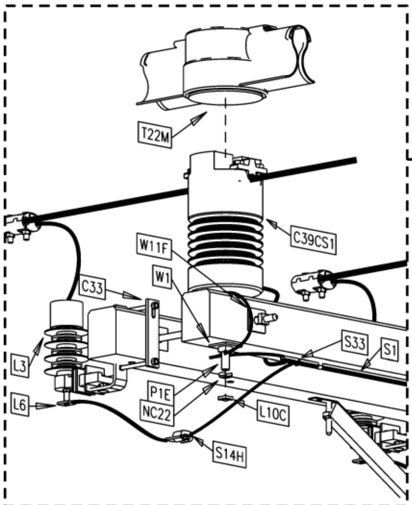
ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD
7/14	15-503	

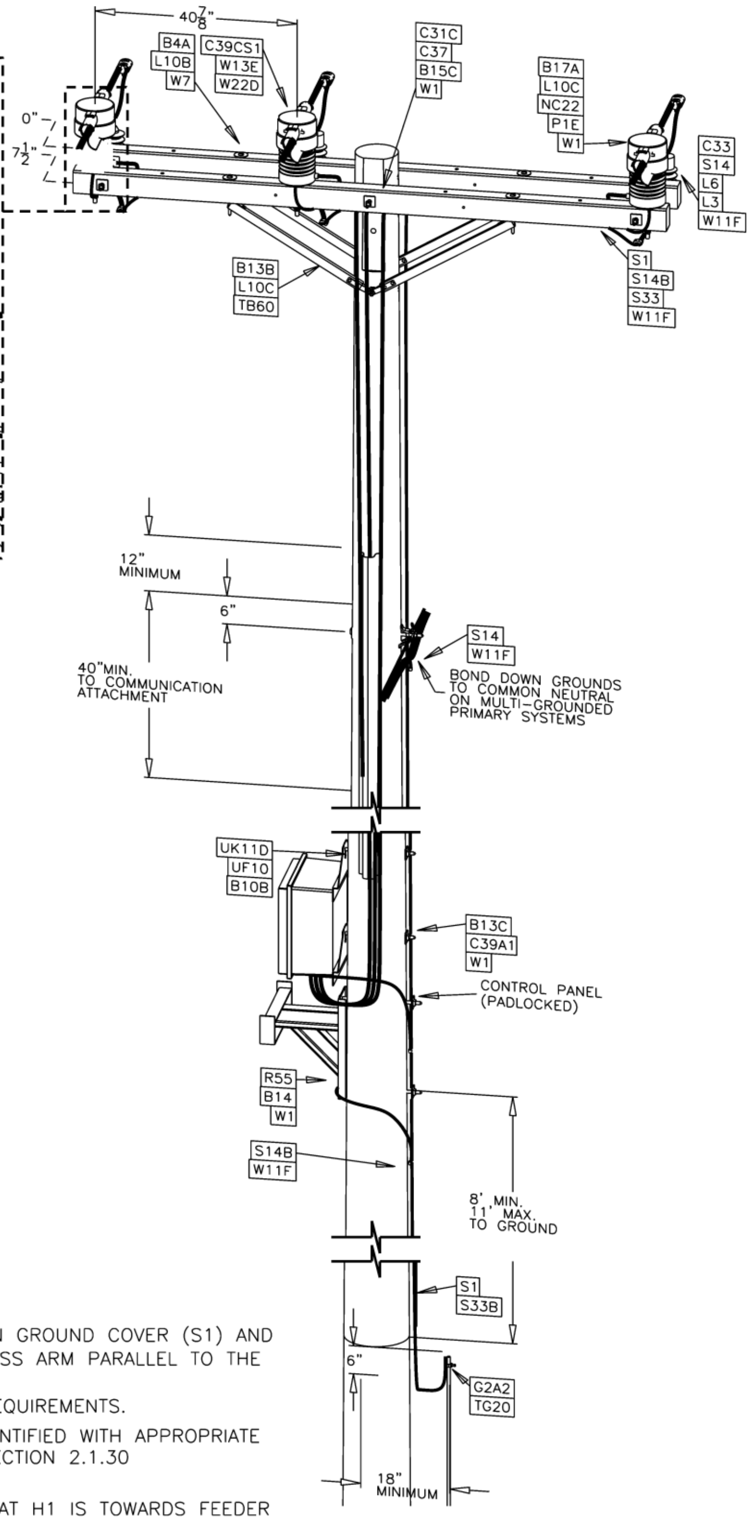


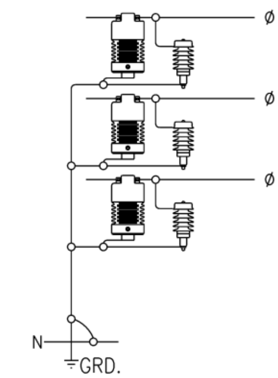
7/15 - New Drawing

NOTES:

All 1"flex conduit, fittings, clips, animal guards and misc. hardware is available in a kit form (M37). The kit does not include 1" PVC conduit







WIRING DIAGRAM

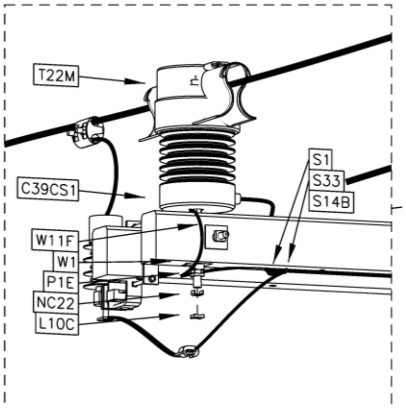
NOTES:

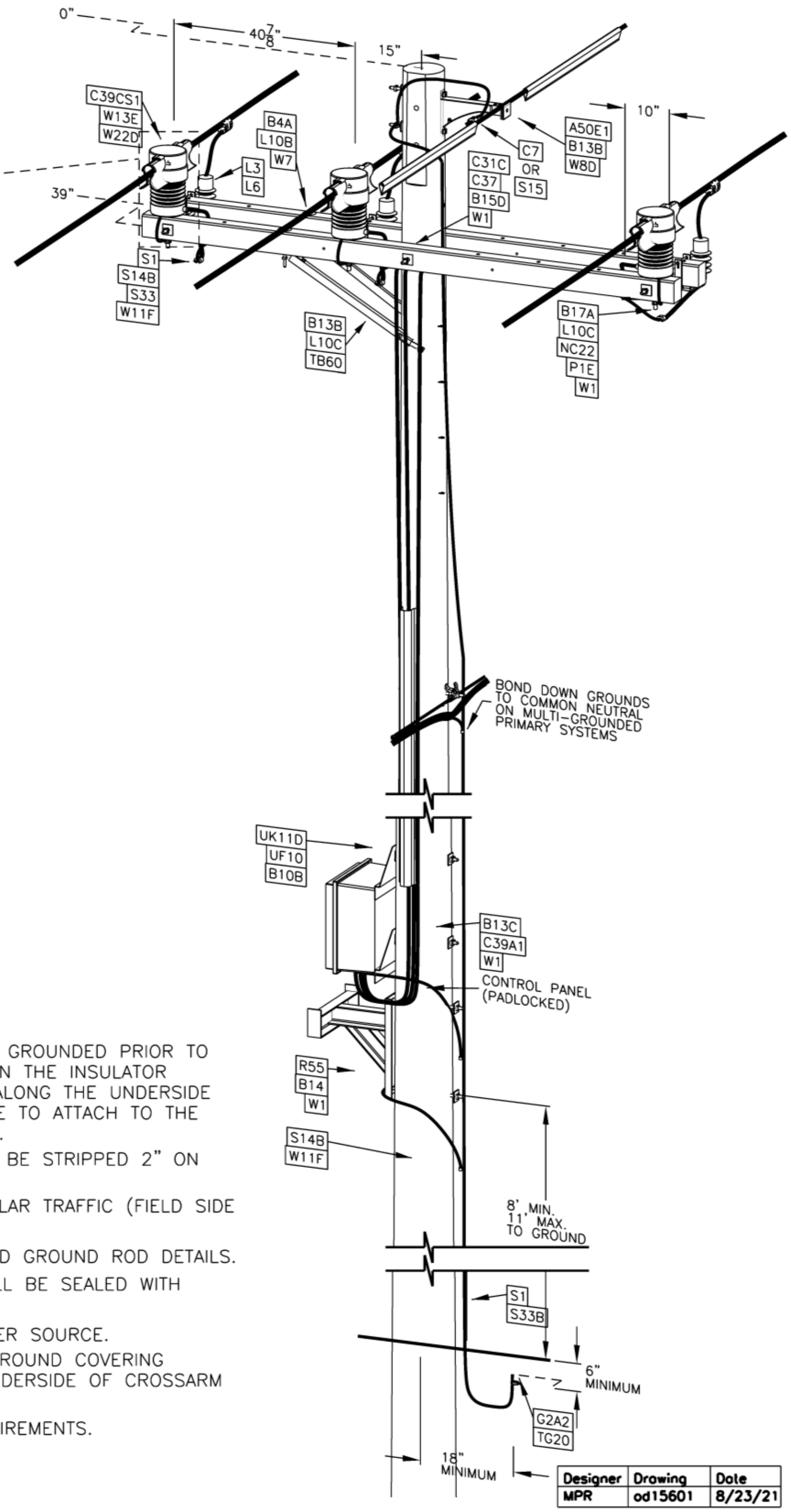
1. CONTROL CABLE SHALL BE RUN IN GROUND COVER (S1) AND STAPLED ON UNDERSIDE OF THE CROSS ARM PARALLEL TO THE GROUND WIRE.
2. SEE SECTION 25 FOR TELECOM REQUIREMENTS.
3. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30
4. MAXIMUM LINE ANGLE 10°
5. ORIENT LINE POST SENSOR SO THAT H1 IS TOWARDS FEEDER SOURCE.
6. REFER TO 13-113 FOR CONTROL CABINET GROUNDING REQUIREMENTS.
7. COVERED PRIMARY CONDUCTOR MUST BE STRIPPED 2" ON EACH SIDE OF SENSOR.

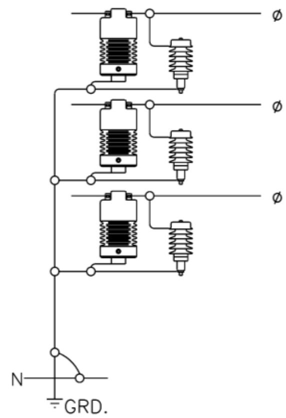
Designer	Drawing	Date
MPR	od15600	7/9/21

3Φ POLE MOUNTED FEEDER MONITOR 15KV

7/21 Issue – New Drawing





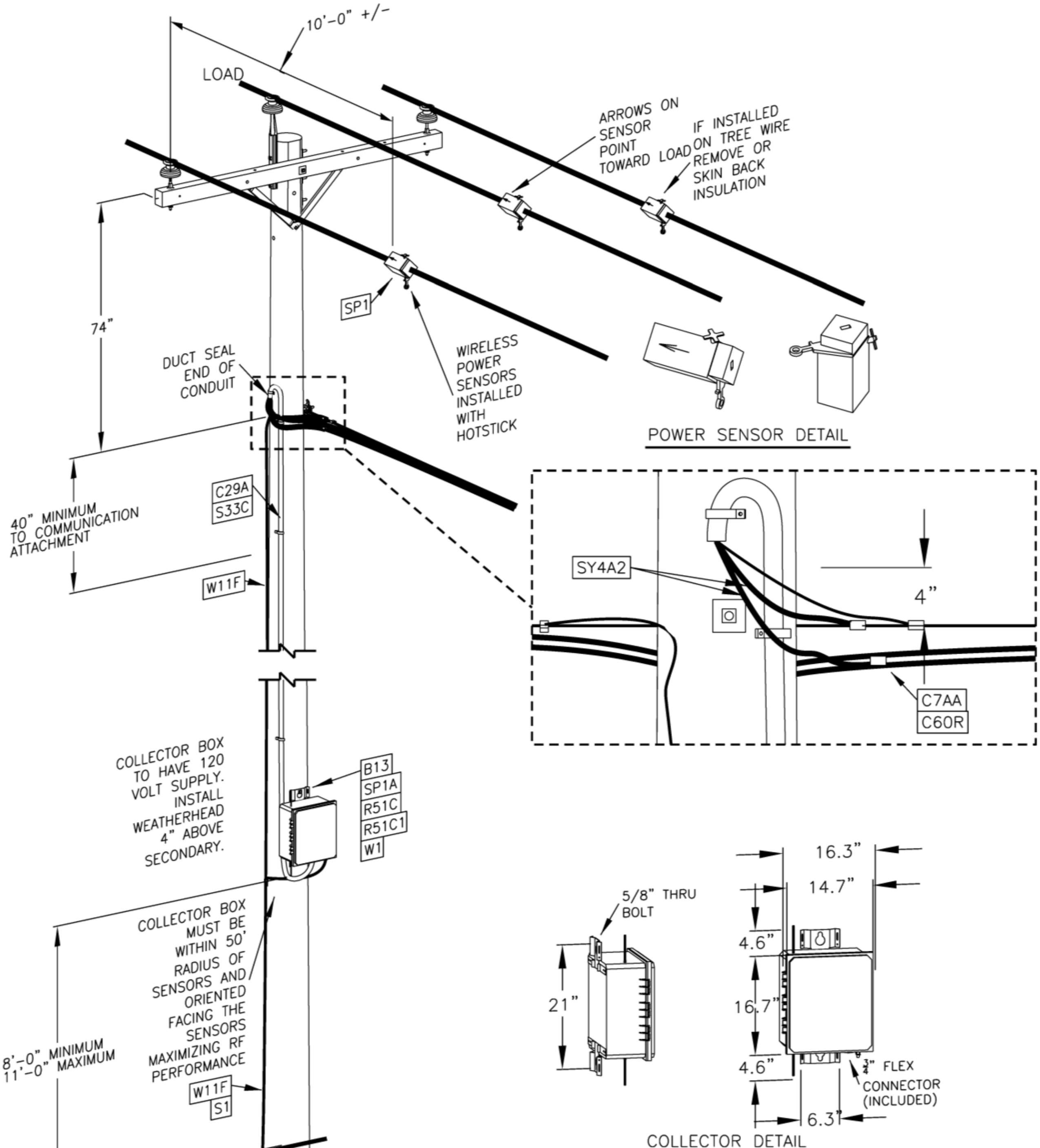


WIRING DIAGRAM

NOTES:

1. SENSOR PIN P1F1 OR P1G MUST BE GROUNDED PRIOR TO ANY ENERGIZED PHASE BEING PLACED ON THE INSULATOR SENSOR. GROUND SHALL BE ATTACHED ALONG THE UNDERSIDE OF THE CROSSARM AND DOWN THE POLE TO ATTACH TO THE GROUND SYSTEM. SECURE WITH STAPLES.
2. COVERED PRIMARY CONDUCTOR MUST BE STRIPPED 2" ON EACH SIDE OF SENSOR.
3. LOCATE CONTROL AWAY FROM VEHICULAR TRAFFIC (FIELD SIDE OF POLE).
4. SEE SECTION 13 FOR GROUNDING AND GROUND ROD DETAILS.
5. BOTH ENDS OF UDUCT (UK11D) SHALL BE SEALED WITH EXPANDING FOAM (UF10).
6. CONTROL REQUIRES SECONDARY POWER SOURCE.
7. CONTROL CABLE SHALL BE RUN IN GROUND COVERING MOLDING (S1) AND STAPLED ON THE UNDERSIDE OF CROSSARM PARRELLEL TO THE GROUND.
8. SEE SECTION 25 FOR TELECOM REQUIREMENTS.

3Φ POLE MOUNTED FEEDER MONITOR 15kV – SPACER CABLE			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 15-601	ISSUE 7/21



NOTE:
1. MINIMUM/MAXIMUM CONDUCTOR SIZE #2 TO 477KCMIL.
2. REQUIRES HORIZONTAL CIRCUIT CONSTRUCTION (NO HENDRIX).
3. SEE SECTION 25 FOR TELECOM REQUIREMENTS.
4. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30
5. REFER TO 13-113 FOR CONTROL CABINET GROUNDING REQUIREMENTS.

Designer	Drawing	Date
MPR	od15650	5/14/21

Supersedes 7/20 Issue – Updated drawing.

Version	Date	Modification	Author(s)	Approval by (Name/Title)
4.0	7/21	• Updated drawings 15-111 thru 15-156, 15-160, 15-600, 15-650 and added new drawing 15-601 • Drawing update 15-211, 15-212, 15-331, 15-332, 15-333, 15-334, 15-334A, 15-335, 15-15-335B, 15-336, 15-363, and 15-409		
3.1	7/20	• Text update in 15.4.10 and 15.6.10 • Drawing Update 15-335 and15-600 changed to C31C crossarm • Added phase and feeder numbering		
3	7/19	• Revised notes on 15-151, 15-153, and 15-154 to provide clearance requirements to communication wires and cables. • Update to drawings 335 336, 406, 407, 600 and 650. • Update to notes pages 335A and 336A. • Update to 15.3.20 text. • Update to table 1 • Added section 15.4.2 • Updated drawings 15-111, 15-113 thru 15-154 and 15-156		
2.10	7/18	• Update to table 1 • Text shift pages 15-2 thru 6		
2.9	7/17	• Update to 13.3.10 text • Update to table 1 page 15-2 • New drawing 15-334A • New drawing 15-160 • Added ladder bracket in 15-122, 15-131, 15-151, 15-153, 15-154,		
2.8	7/16	• Revised Pg 15-4. Added Page 15-5 with Section 15.6. - Line Sensors. • Added drawing 15-650 • Revised title and note on 15-600 • Revised titles for pages 15-151 & 15-152. • Added ground mat note and primary tap and neutral wire sizes to 15-151, 15-153 & 15-154.		
2.7	7/15	• New Drawing 15-550 • Changed pole spacing and added notes and tie-down clips to platform regulators (15-151 through 15-156).		
2.6	7/14	• Section 15.3.20 update. • Updated numbering for section 15.4 and 15.5 • New section 15.6 • Updated drawings 15-332, 15-334, 15-335, 15-335A ,15-336 15-500,15-501, and 15-502 • New drawing 15-503 and 15-600		
2.5	7/13	• Corrected Drawing 15-500		
2.4	7/12	• Updated table 1 • Updated 15-152 and 15-156 item 6 EOP referral • Drawing updates to 15-122, 331, 332, 333, 334, 335, 336, 400, 402, 404, 407 and 409		

Version	Date	Modification	Author(s)	Approval by (Name/Title)
2.0	7/11	• Revised 15-122 – revised wiring diagram to show Reg#1L lead connected to Line 3 instead of tap to Reg# 3. • Revised 15-151 thru 15-154 – changed tap insulators to poly instead on porcelain. • Revised 15-211 – added washer • Revised 15-212, 15-331, 15-322, 15-333, & 15-334 – added washer and changed pole top clearance to 7 ½" • Added new standards 15-335 and 15-336		
1.1	7/10	• Revised MU's on 15-111, 15-122 & 15-131 • Added Regulator Platform drawings 15-151 thru 15-156 • Added By-Pass Switch Operation Guide 15-157 • Revised meter socket wire labeling 15-399 • Corrected Std Item # on 15-400, 15-402 and 15-404. • Revised Drawings 15-500, 15-501, and 15-502. Added more details on each drawing.		
1.0	7/09	• Renumbered sections of the document. • Added Section 15.5 (Primary Metering). • Updated drawing 15-333 • Updated drawing 15-334 • Added Drawing 15-399 • Revised Drawing 15-407		

Supersedes 7/07 Issue – Revised 16.7 page numbering

Supersedes 7/07 Issue – Revised Title of Section 16-153

Supersedes 7/07 Issue – Revised Index Added 16-NOTES

Supersedes 1/06 Issue – Revised WARNING To Reflect The Addition Of A Semiconducting Layer For All New Spacer Cable / Tree Wire

16.0 SCOPE

This Standard includes the basic philosophy, design, and recommended practices for all new spacer cable distribution line construction at voltages of 35 kV and below as well as for all new aerial cable construction at voltages of 15 kV and below.

16.1 APPLICATION

16.1.10 Safety Cautions

A. **WARNING:** Although spacer cable coverings offer some electrical protection, **SPACER CABLE CONDUCTORS ARE NOT INSULATED. THEY MUST BE TREATED AS BARE CONDUCTORS DURING INSTALLATION AND MAINTENANCE.**

B. **WARNING:** All new spacer cable coverings contain a layer of semiconducting material right at the aluminum conductor surface. **WHEN SKINNING ALL SPACER CABLE COVERINGS, DO NOT ALLOW THE REMOVED COVERING TO COME IN CONTACT WITH GROUND OR ANOTHER PHASE. A FLASH MAY RESULT.**

16.1.20 Recommended Applications

Spacer cable systems are recommended for the following applications:

A. Heavily treed areas where tree removal is not possible.

B. Areas where proper horizontal line clearances cannot be maintained using other construction alternatives.

C. Areas where multiple primary feeders on the same pole line are required.

D. Areas where right-of-way space is limited.

16.2 GENERAL

16.2.10 Spacer Cable System

An overhead primary distribution system consisting of covered conductors held in a close triangular configuration by spacers that are supported by a messenger and attached to brackets on a pole.

16.2.20 Basic Impulse Level (BIL) in a Spacer Cable System

BIL in a spacer cable system is dependent upon the coordinated insulation capabilities of the individual parts making-up the spacer cable; insulation covered conductor, spacers, conductor ties, and grounded messenger.

The messenger is required to be grounded approximately every 800 feet, every other pole is recommended, to aid in preventing lightning flashover resulting in conductor burn down. Thus, the basic pole top is shielded and grounded.

Basic impulse level is determined primarily by two factors: (1) inches of insulating material between conductors and (2) conductor cover thickness. Estimated minimum impulse withstand for a 15 kV class spacer cable system without conductor insulation removed, or surge arresters installed, is 280 kV.

Note: When spacer cable covering is removed and the conductors remain in their normal close configuration, the BIL is lowered. Arresters shall be applied per Section 16.3.40-Surge Protection, to reduce the possibility of flashover to the messenger or to an adjacent phase conductor. Furthermore, all phase conductor taps shall be taped or covered to help minimize the potential for flashover.

16.2.30 Design Basis for Individual Poles

A. NESC (National Electrical Safety Code - ANSI C-2)

1. Loading – Heavy loading in accordance with latest edition of the NESC.

2. Vertical Clearances – Sag Related Clearances.

   Messenger at worst final sag producing condition (of four conditions listed below)

   - Ambient temperature of 0˚F/-18˚C with 4 lbs. wind and with ½ inch ice, or
   - Ambient temperature of 32˚F/0˚C with no wind but with ½ inch ice, or
   - Ambient temperature of 60˚F/15˚C with 6 lbs. wind but with no ice.
   - Maximum conductor operating temperature under unloaded conditions.

   Any conductors below the spacer cable configuration, at same operating ambient, final, unloaded (no ice) sag.

   Midspan clearances must be 75% of those required at the pole.

3. Grades of Construction – NESC specifies three grades of overhead power line construction based on required strengths for safety.

   The relative order of grades for conductors and structures is B, C, and N, with grade B being the highest.

   The Company Distribution Construction Standards are designed predominantly for grade C, except where grade B construction is required (mainly where supply conductors cross either a railroad or a limited access highway). Grade N construction is not used by the Company for distribution construction.

B. Ownership/Attachments – Poles are jointly owned with the telephone company. Company designed space is based on two additional communication cables being installed in the communication space, such as fire alarm and cable TV. Both pole owners, by agreement, relinquish 12 inches (i.e., 6 inches per attachment) of vertical ownership area in order to maintain the 40 inch required communication worker safety space at the pole. Additional third party attachments each require that both parties relinquish an additional 6 inches.

C. Primary Conductors – Maximum phase conductor size of 795 kcmil installed using a 1/0-2/5 AWAC messenger.

D. Definition of "S-S" – Indicates that the neutral of the secondary supply cable is located on the pole in this position.

To allow room for connections to the cable, the lowest secondary supply conductor is located 6 inches below S-S.

Supersedes 1/06 Issue – Revised Vertical Clearance Requirements, Max. Conductor Size & Added Ownership Clarification

E. Secondary Conductor/Neutral – Use of 3/C-1/0 aluminum secondary cable per Section 10-Secondaries, with its messenger attachment located at Line S-S.

Installation of a single 1/0 6201 neutral in place of secondary cable requires sags of the single 1/0 neutral to match those of secondary cable.

Clearances in this Standard do not allow for the vertical space required by any existing secondary racks. If racked secondary exists, it shall be replaced with standard secondary cable.

F. Use of Messenger as the Sole Neutral – In special instances the messenger may be used as the circuit's only solidly grounded neutral conductor.

Grounding shall be as specified in Section 13-Grounding.

Transformer or other equipment neutral taps to the messenger shall be made using covered conductor having equal ampacity to that of the equipment phase lead.

G. Top Communication Cable Sags – No sag assumed.

H. Supply Space Communication Conductors – Shown in construction drawings for reference purposes only. Poles in this standard are not specifically designed to accommodate these conductors. See the Company "Policy For Installing Communication Cables In The Supply Space."

16.2.40 Thermal Ratings

A. Normal & Emergency – Refer to Section 6-Primary Conductors.

B. Sags for Clearance Purposes – Using the NESC conditions in Section 16.2.30-Part A. above, refer to Sag & Tension Tables in 16.5-Messenger and Phase Conductor Installation for specific values.

16.3 PRACTICES

16.3.10 Guying

A. Shall be in accordance with that specified in the individual drawings in this Section and per requirements of Section 3-Guying.

B. A messenger designed storm loaded tension of 6,800 pounds, in accordance with Section 16.4-Deadending, Splicing, and Splice Recovering, shall be used for purposes of guying.

C. Maximum allowable angles in a line may be limited by the ability to properly guy the pole.

D. All spacer cable deadends and angle poles in excess of 30 degree line angles require a minimum of a double 12.5M guy strand and compatible hardware.

E. Obtain the maximum guy lead possible. A ratio of Height /Lead ≤ 1 is preferred. Short leads (5-10 feet) can result in pole splitting, excessive column loading, and anchor creepage.

F. Fiberglass guy strain insulators shall be used in accordance with individual drawings in this Section and will generally be located on every primary down guy.

16.3.20 Installation

A. Poles – Shall be as shown on individual construction drawings in this Section. Pole height is dictated by what equipment is installed on the pole, whether joint use is required, span lengths, and size and type of conductors installed.

Pole class shall be determined by Distribution Design in accordance with Section 2-Poles/Hardware. Specific design criteria listed in Section 16.2.30-Design Basis for Individual Poles above, have been applied to the individual pole construction drawings in this Section.

B. Brackets

1. Tangent Brackets – Are designed for messenger support on straight line poles up to a maximum line angle of 6 degrees.

   Tangent brackets provide three messenger offset distances from the pole: 14, 24, and 44 inches.

   Note: The 24 inch bracket must be used on 35 kV straight line poles in order to provide required clearance from the pole surface.

2. Anti-Sway Brackets – Are designed for spacer support on transformer tap poles and areas that are subject to high wind (e.g., coastal construction). All 15 kV transformer tap poles should utilize the anti-sway bracket to help minimize potential damage to tap connections at these locations. Additionally, these brackets are available for use in high wind areas (Std. Item A54B).

3. E-Brackets – Are designed for angle construction at 15 kV up to a maximum line angle of 60 degrees.

   For guying purposes, the line angles for E-Brackets are broken down into “light angle” (6-30 degrees); and “heavy angle” (31-60 degrees).

   The E-Bracket shall not be used at 25 kV or 35 kV, as it does not provide required clearances.

4. C-Brackets – Are designed for use at 15 kV for line angles from 61-90 degrees. Adapter plates, double pins, and pin insulators must be used at these line angles to split the conductor angle to control stress cracking of the conductor covering.

5. C-Brackets, Braced – Are designed for use at 25 kV & 35 kV. They provide required clearances for these voltages classes.

   Since E-Brackets cannot be employed at 35 kV, the braced C-Bracket is designed for use with line angles between 6 and 90 degrees.

6. 6. 60-inch Metal Pole Top Extension – Is designed to provide approximately 48 inches of added height, where needed, to an existing pole that otherwise doesn’t warrant replacement.

   Individual construction drawings in this Section detail maximum span lengths when these brackets are used with existing pole heights.

   The 60 inch pole top extension shall only be employed on straight line poles and at line angles not exceeding 30 degrees, as shown in this Section.

Supersedes 7/07 Issue – Text shift

Pole top extensions should not be used repeatedly for more than four or five spans in order to limit the extent of pole top damage that might occur during pole or span impact.

C. Messenger – Properly guyed structures are critical to maintaining installed spacer cable system's designed sags and tensions, which meet NESC clearance requirements.

Install messenger in accordance with Section 16.5-Messenger and Phase Conductor Installation instructions, sags and tensions. Use approved running blocks and safety methods. Poles shall be prepared prior to pulling the messenger to insure that electrical contact will not occur during pulling. Do not pull messenger over crossarms, brackets or other means of support, as messenger damage may occur.
Do not over tension messenger during initial installation. Doing so will result in storm loaded tensions that are excessive of those designed for the installed system. Anchor pulling, pole splitting, and hardware breakage may result.

1. Permanent Stringing Angle Clamp PSAC
The PSAC is a combination stringing block and messenger clamp. The PSAC allows the messenger wire to be pulled in, tensioned and clamped using one piece of hardware. For use when installing messenger wire on E brackets at max 60 angle.

Supersedes 7/11 Issue - Added PSAC

D. Phase Conductors – Install in accordance with recommendations in 16.5-Messenger and Phase Conductor Installation.

PHASE CONDUCTORS SHALL BE TREATED AS IF THEY WERE BARE CONDUCTORS AT ALL TIMES DURING INSTALLATION AND MAINTENANCE.

Particular attention must be given to obtain recommended phase conductor sags between spacers during installation to avoid over-tensioning. During cold weather, over-tensioned phase conductors will cause angle bracket insulator pin bending, overstressing of phase conductor covering, splice failure, and phase conductor contact with grounded brackets, all of which can lead to failure of the system.

E. Conductor Ties

At spacers – For maintenance on poles utilizing the older spacer design, use molded EPDM rubber ring ties furnished with spacers. New spacer designs do not require rubber ring ties as this design utilizes a built-in latch for securing conductors.

At pin type polyethylene insulators – Preferred – Thermoplastic Rubber (TRP) covered, solid, soft drawn (SD) #4 aluminum tie wire (Std. Item W22D).

On C-Brackets or on crossarms, where double pins and insulators are called for, an alternate method utilizing molded plastic ties or "jar rubbers" may be used for ease of installation. Manufacturer's recommendations must be followed to insure proper installation.

Do not remove factory insulation covering at spacers or at polymer pin insulators for any of the above tying methods.

F. Spacers

1. Placement – Shall be as shown on individual drawings in this Section.

   Tangent Brackets – Install two spacers, one on each side of the bracket, about six inches from the bracket.

C or E-Brackets – Install first spacer approximately 30 feet either side of the bracket.

At Crossarm Deadends – Install double spacers approximately 50 feet out from the crossarms.

Span Between Poles – Install spacers as close as practical to 30 foot spacing.

2. Maintenance – When replacing broken or damaged spacers, the new spacers shall be placed a few inches away from the old location to utilize a “fresh” portion of conductor covering.

G. Insulators

1. Pin Type – 15 kV and below – A one piece, molded 15 kV pin-type polyethylene insulator shall be used.

2. Pin Type – 25 kV and 35 kV – A one piece, molded 35 kV pin-type polyethylene insulator shall be used.

3. Deadends – Polymer one-piece insulators shall be used at both voltage levels above in accordance with individual drawings in this Section.

   Note: There are some construction designs that require an added insulator for increased electrical isolation.

4. Maintenance – When performing maintenance or in the process of converting to higher voltage levels, older porcelain pin insulators shall be replaced with polyethylene units, provided conductor covering is not damaged.

   If conductor damage is present, Standards Engineering shall be notified. New conductor may have to be spliced in and splices recovered per 16.4-Deadending, Splicing, and Splice Recovering.

H. Deadends

1. Messenger – Deadends shall be made with approved formed wire grips as shown and listed in Section 16.4-Deadending, Splicing, and Splice Recovering.

2. Phase Conductors – The preferred method for deadending is by use of approved straight, bolted strain clamps as shown in 16.4-Deadending, Splicing, and Splice Re-Covering.

   The alternate method of deadending is with the use of formed wire grips installed directly over the conductor covering. This method is shown in 16.4-Deadending, Splicing, and Splice Re-Covering.

   In no instance should formed wire grips be used to deadend covered conductors installed using crossarm construction. Formed wire grips require support by a messenger.

I. Tapping Conductors

1. Location – Locate taps a minimum of 30 inches away from any grounded bracket as shown in individual standards.
   Multiple taps, as in the case of two-and three-phase applications, shall be staggered a minimum of 30 inches from each other.

Supersedes 7/11 Issue – Text shift

2. Skinning Cautions – **WARNING**: Since some coverings contain a layer of semiconducting material at the metal conductor surface, it is important when skinning all spacer cable conductors, not to let the removed covering get so long that it could come in contact with another phase or ground. An electrical flash may result.

3. Tools – Coverings shall be removed using approved strippers listed in Table 5 on Page 16-13. **Conductor damage may result from not selecting the right stripping tool for the conductor involved.**

4. Skinning Lengths – Shall allow for approximately 3 inches either side of the connector.

5. Lead Training – Tap leads shall be trained around the spacer cable bundle as shown in individual construction drawings. **Tap leads shall not be routed between phases in the spacer bundle.**

6. Connectors – Use appropriate connector for desired application as specified in Section 5-Connectors.

   Connectors of covered tap leads without proper lightening protection at immediate pole location shall be covered by gel wrap (STD C67, C68). See section 13.6.30 for proper lightening arrester installation.

7. Messenger Covering – Shall be installed in lengths specified by individual Standards. Messenger covering shall be secured using a connector (STD Item C7) for the specified conductor as outlined in Section 5-Connectors. Messenger covering is installed to prevent wildlife and tree contact from occurring.
   WARNING: MESSENGER COVERING IS NOT RATED FOR ELECTRICAL PROTECTION AND THEREFORE SHALL NOT BE USED FOR WORKER PROTECTION.

J. Splicing & Recovering

1. Messenger – Full tension automatic splices shall be used in accordance with Section 16.4-Deadending, Splicing, and Splice Recovering.

2. Phase Conductors – Full tension compression splices shall be used in accordance with Section 16.5-Deadending, Splicing, and Splice Recovering. **WARNING:** DO NOT USE AUTOMATIC SPLICES. AUTOMATIC SPLICES REQUIRE THAT THE CONDUCTOR BE HELD UNDER TENSION AND THIS IS NOT THE CASE FOR **PHASE CONDUCTORS OF A SPACER CABLE CIRCUIT.**

   Splices should be located away from the pole as shown in Section 16.4-Deadending, Splicing, and Splice Recovering, Figure 4 on Page 16-13. This will allow room for **future taps to be made at the splice pole.**

   Splices shall be staggered a minimum of 30 inches as shown in Section 16.4-Deadending, Splicing, and Splice Recovering.

   New construction shall utilize either the “cold shrink”, “hand applied tape” or the “gel wrap” method for recovering as shown in Section 16.4-Deadending, Splicing, and Splice Recovering, Figure 4 on Page 16-12.
   Do not install splices at or near polyethylene pin insulators or spacers.

Supersedes 7/11 Issue – Added connector STD ID to 16.3.20 I.7

16.3.30 Grounding

A. Messenger – Ground messenger in accordance with drawings in this Section and practices in Section 13-Grounding.

Messenger to be electrically direct connected to the system neutral at every pole.

WARNING: MESSENGER GROUNDING BY GROUNDING ITS' SUPPORTING BRACKET SHALL NOT BE PERMITTED. This creates a high resistance connection. Messengers are to be electrically connected to driven ground rods at intervals not to exceed 800 feet, preferably at every other pole; a driven ground rod at a transformer or other equipment counts toward satisfying this requirement.

B. Brackets – All messenger and phase conductor supporting brackets shall be bonded to the pole equipment grounding conductor as shown in individual drawings in this Standard.

All other brackets, such as capacitor racks, recloser racks, transformer cluster mounts, and metering racks shall be grounded in accordance with specific Standards in this book (Refer to Section 13-Grounding).

Single phase fiberglass equipment mounts (Std. Item E13M) shall be used for mounting all fused cutout assemblies, fused cutout / arrester assemblies and terminator / arrester assemblies located on a spacer cable system. The practice of utilizing metal equipment mounts for such applications shall be discontinued for new spacer cable construction; however, existing installations shall remain in service unless the structure is being significantly rebuilt (e.g., reconductoring, structure replacement, etc.) in compliance with the latest Standard.

C. Guys – Guys shall be insulated and/or grounded. The Company calls for grounding guys below their guy strain insulators when down-guying.

Refer to Section 3–Guying for additional guying detail.

D. Television and Radio Interference – The higher the primary voltage, the greater the possibility of generating radio and television interference.

This interference can be controlled by taking reasonable care to properly install connectors per the manufacturer's recommendations and Company outlined practices located in Section 5-Connectors as well as by properly maintaining suitable clearances between un-bonded metal pole line hardware, and by ensuring that all hardware is properly tightened.

25 kV and 35 kV construction standards call for double coil lock washers to be used with all bolts and lag screws in the process of securing metal hardware to wood structures.

The minimum clearances from unbonded metal to other metal are:

FEEDER VOLTAGE (PHASE – TO – GROUND)	CLEARANCE IN INCHES
15 kV and Below	3
Above 15 kV – 20 kV	4½"

Supersedes 7/07 Issue – Text shift

E. Arresters – Ground rods are required at every surge arrester location.

All arresters require a direct electrical connection to a grounding conductor which is connected to a driven ground rod.

WARNING: IN NO INSTANCE SHALL ARRESTER GROUNDS BE TIED TO THE SYSTEM NEUTRAL CONDUCTOR ONLY, WITHOUT INSTALLING A DRIVEN GROUND ROD AND GROUNDING CONDUCTOR. Ground leads should be kept as short as possible.

The arrester ground lead shall be trained to allow for proper arrester disconnect operation. This means that the disconnect point be allowed to break free from the arrester housing. Standard construction for surge arrester application calls for a flexible line arrester grounding lead (Std. Item L6) which will accommodate the proper disconnect operation of the device.

F. Bonding of Cable Messengers Located in the Communication Space – Pole equipment grounding conductor shall be bonded to communication cable messengers in accordance with Pole Joint Owned Practices.

16.3.40 Surge Protection

A. Application – Arresters shall be:

1. Applied in accordance with Standards in Section 13-Grounding.
2. Located at all end-of-line spacer cable deadends.
3. Installed at all deadends and junctions with bare or covered line conductors.
4. Installed at switch locations. Arresters are to be installed on the both sides of the switch.
5. Installed at riser poles. **Note:** Riser type arresters must be used on riser poles.
6. Installed at all equipment taps if no arresters exist on the equipment.
7. Installed on the load side of fuse cutouts where practical.
8. Installed at abandoned spacer cable tap skinnings if recovering is not practical.

Messenger grounding and driven ground rods are required at poles either side of the switch pole per Section 12-Protection.

Every attempt shall be made to locate arresters at the tap, junction, or deadend pole itself. Prior practice of installing arresters a pole or two away from a spacer cable junction shall be discontinued.

B. Tree Trimming

Spacer cable systems are designed to be installed in highly treed areas, or where required physical separation from buildings cannot be met with crossarm construction. They are not intended to be installed to eliminate trimming.

Spacer cable phase conductors have the ability to withstand momentary contacts with tree limbs and branches, wildlife, and other airborne objects.

WARNING: Continuous tree contact should not be allowed at any voltage. Erosion of the cover will result and lead to its puncture and conductor damage, and may result in conductor burndown.

Cover erosion rates increase approximately with the 6th power of the voltage. Therefore, during continuous tree contact, 35 kV circuits can be expected to fail approximately 200 times faster than 15 kV circuits.

Trimming priorities should first address circuits of higher voltage.

16.4 DEADENDING, SPLICING & SPLICE RECOVERING

16.4.10 General

This Section covers recommended methods of deadending, splicing, and splice recovering of the various spacer cable messengers and phase conductors.

16.4.20 Messenger Deadending

HARDWARE – Refer to the following, Figure 1, for messenger deadend assembly hardware. Do not use D-eyes with formed wire grips.

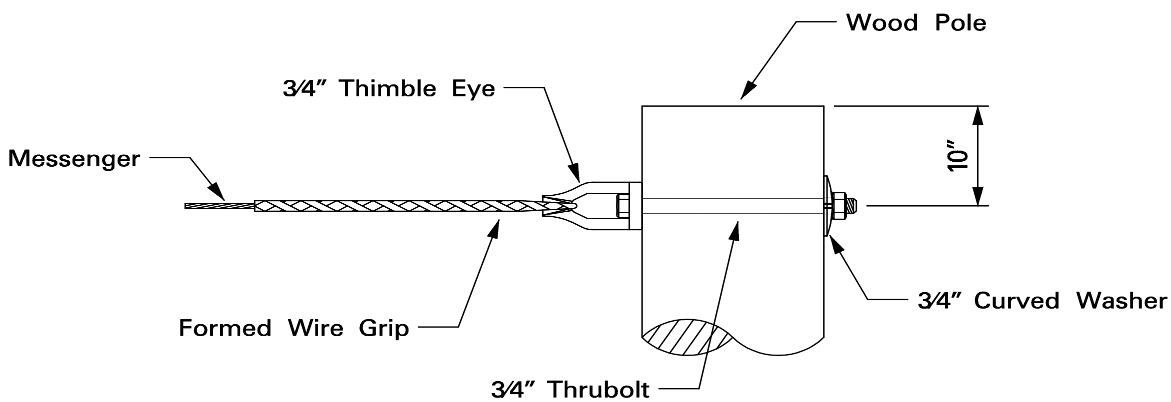


Figure 1

DEADENDS – Use formed wire messenger deadends as shown in Table 2.

TABLE 2
Formed Wire Messenger Deadends

MESSENGER		SAP ITEM ID	PS ITEM ID
NEW CONSTRUCTION	MAINTENANCE		
1/0 – 3/4 AWAC		9313477	3503569
	1/0 – 4/3 AWAC	9313350	5989142[E]
	⅜”, 7 - #8 CW	9320255	5989135[E]

16.4.30 Phase Conductor Deadending

There are two approved methods for deadending phase conductors: (1) use aluminum strain clamps, or (2) use formed wire deadends. Method (1) must be used at 35 kV.

Supersedes 7/07 Issue – Revised Table 2 to include SAP Item ID #s.

Supersedes 7/07 Issue – Revised Table 3 to include SAP Item ID #s

Aluminum Strain Clamps – Use aluminum strain clamps per Section 5-Connectors. Allow enough phase conductor tail out of the strain clamp to make arrester and other tap connections. Avoid tapping the span if possible. See Figure 2 below.

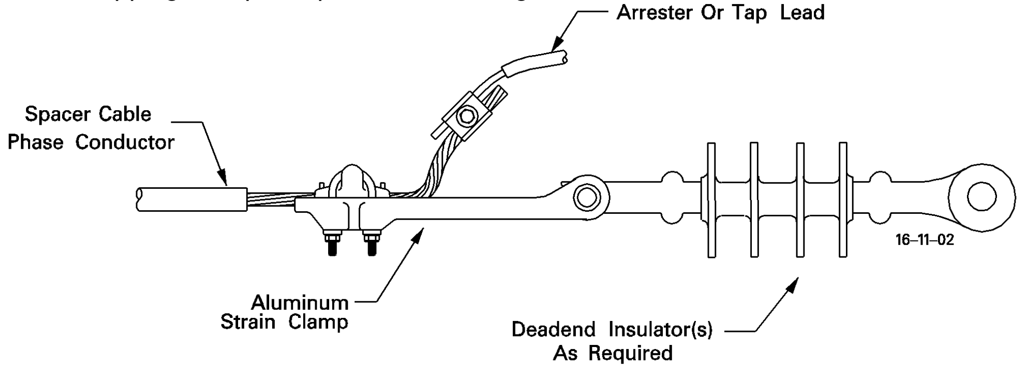


Figure 2

Formed Wire Deadends – Refer to Figure 3 below. Use phase conductor formed wire grips listed in Table 3.

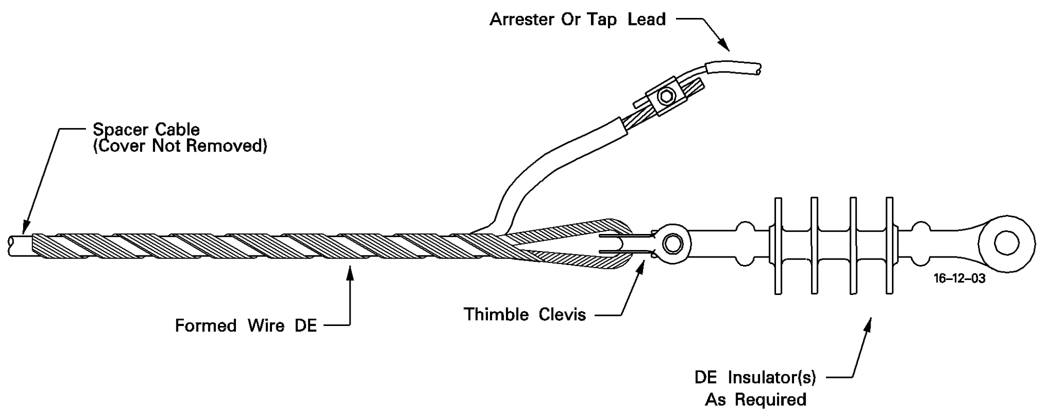


Figure 3

TABLE 3
Phase Conductor Formed Wire Deadends

CONDUCTOR		SAP ITEM ID	PS ITEM ID
NEW CONSTRUCTION	MAINTENANCE		
1/0 – 7 Str 6201-15 kV		9309140	3506748
477 – 19 Str EC-Compact-15 kV		9315735	3506749
336.4 – 19 Str EC-Compact-15 kV		9305136	5106085
795 – 37 Str EC-Compact-15 kV		N/A	5989149[E]
1/0 – 7 Str 6201-35 kV		9315735	3506749
477 – 19 Str EC-Compact-35 kV		9313346	5989151[E]
795 – 37 Str EC-Compact-35 kV		N/A	N/A
	1/0 – 7 Str EC-Compact-15 kV	9313348	5989145[E]

16.4.40 Messenger Splicing

Use automatic splices or full-tension compression splices listed in Table 4 below. It is pertinent to an electrical connection that the conductor be properly cleaned; therefore, wire brush all conductors prior to splicing.

TABLE 4
Messenger Splices

MESSENGER TO BE SPLICED		SPLICE TYPE	ITEM ID	SPLICE CAT NO	TOOL	DIE	TOTAL CRIMPS
NEW CONSTRUCTION	MAINTENANCE						
1/0 – 3/4 AWAC		Automatic	9313755	Fargo GLA – 1165			
1/0 – 2/5 AWAC		Compression	9313754	Burndy YDS7M6TG2	Y - 35	U 679	4
	1/0 – 4/3 AWAC	Automatic	9313755[E]	Fargo GLA – 1165			
	⅜”, 7 – #8 CW	Automatic	9313288[E]	Fargo GLA – 812			
	½”, 7 STR 052 AW	Automatic	9305650[E]	Reliable 5044			

16.4.50 Phase Conductor Splicing

Application: Full tension compression splices are used for all new construction.

WARNING: DO NOT USE AUTOMATIC SPLICES.

Splice Location: Figure 4 below shows the preferred location for splicing. Splices should be located a minimum of 60 inches from a pole to allow for future taps to be made at that pole.

Splices should be staggered along the spacer cable circuit keeping 30 inch minimum between recovered splice ends. This helps to maintain designed BIL’s, and is particularly important because field applied recovering may not be electrically equivalent to factory applied covering.

Because the splice will be covered, it is not necessary to install messenger covering (line duct) on the messenger in the splice vicinity. Messenger covering does little to increase spacer cable BIL levels and is not required for wildlife protection.

Supersedes 7/07 Issue – Revised Table 4 to include SAP Item ID #s

Location of Phase Conductor Splices

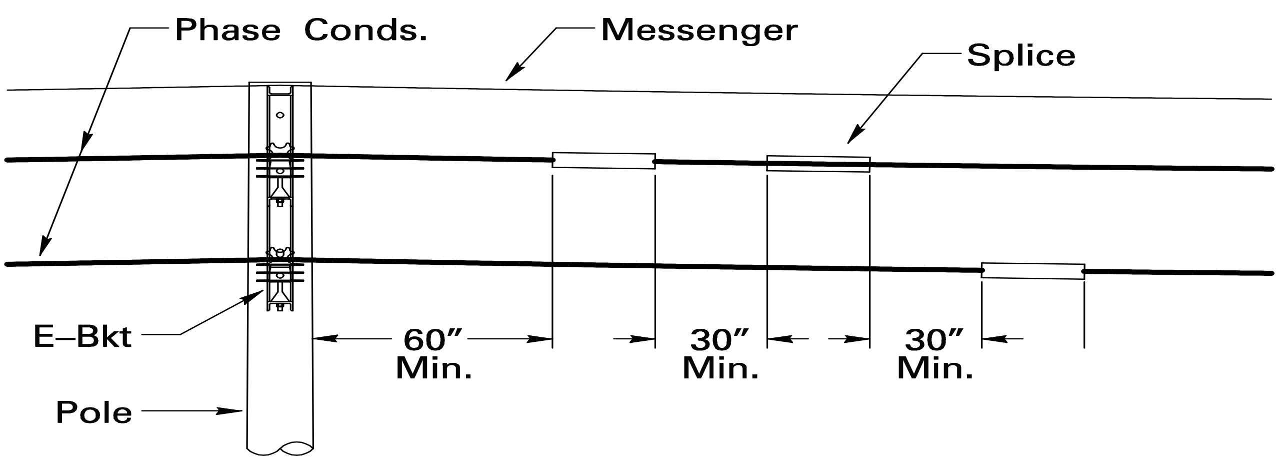


Figure 4

Supersedes 7/07 Issue – Revised Table 5 to include SAP Item ID#s

Conductor End Preparation: Using a stripping tool from Table 5 below, remove the covering a distance equal to ½ the uncrimped splice length plus 1½ inches. Use care not to nick the conductor strands. Refer to Figure 5 below.

TABLE 5
Spacer Cable Stripping Tools

Spacer Cable	SAP Item ID	Cond O.D.	Cov Thkns	Cond Shield	Cover O.D.	Mid-Span Stripper	Spare Blade	Spare Ring Knife
1/0 – 7 Str 6201 – 15 kV	9302832E	0.398”	150 M	15 M	0.728”	WSP1 – 166	CB – 1	N/A
1/0 – 7 Str.AAC – 15 kV*	N/A	0.338”	150 M	15 M	0.638”	WSP1 – 319	CB – 1	N/A
4/0 – 7 Str. EC Compact – 15 kV*	N/A	0.478”	150 M	--	0.778”	WSP1 – 193	CB – 1	N/A
336.4 – 19 Str. EC Compact – 15 kV	9305136	0.607”	150 M	15 M	0.937”	WSP2 – 238	CB – 1	N/A
477 – 19 Str. EC Compact – 15 kV	9302808E	0.722”	145 M	15 M	1.042”	WSP2 – 252	CB – 1	N/A
795 – 19 Str. EC Compact – 15 kV	9313226E	0.932”	160 M	20 M	1.292”	WSP10 – 003	CB – 1	N/A
336.4 – 19 Str. EC Compact – 25 kV*	N/A	0.607”	250 M	15 M	1.137”	WSRK2 – 75	CB8 – 2A	CB19
336.4 – 19 Str. EC Compact – 35 kV*	N/A	0.607”	300 M	15 M	1.237”	WSBK10-133	CB8 – 2B	CB162
795 – 37 Str. EC Compact – 25 kV*	N/A	0.932”	250 M	20 M	1.472”	WSRK10 – 71	CB8 – 2B	CB162
1/0 – 7 Str. 6201 – 35 kV	9313250E	0.398”	300 M	15 M	1.028”	WSK10 – 99	CB8 – 2A	CB19
1/0 – 7 Str. EC Compact – 35 kV*	N/A	0.338”	300 M	15 M	0.968”	WSRK2 – 246	CB8 – 2A	CB19
477 – 19 Str. EC Compact – 35 kV	9313248E	0.722”	300 M	20 M	1.362”	WSK10 – 102	CB8 – 2B	CB162
795 – 19 Str. EC Compact – 35 kV	9313225E	0.932”	300 M	20 M	1.572”	WSK10 – 103	CB8 – 2B	CB162

* Non-STD Conductor

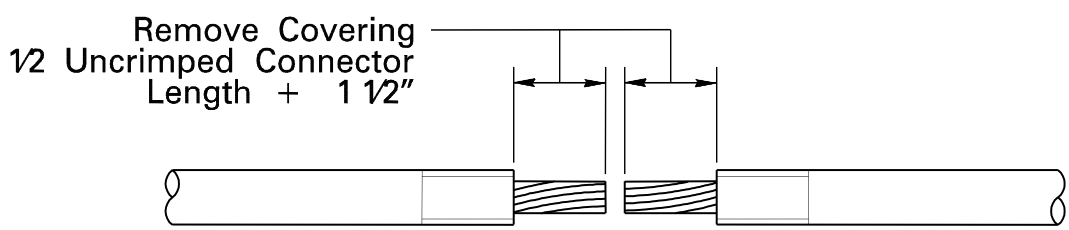


Figure 5

Clean and buff the conductor covering at both ends for a distance of 3½ inches. Use cable preparation kit, Std. Item UC80F, or kit supplied with the packaged cold shrink recovering. Refer to Figure 6 below.

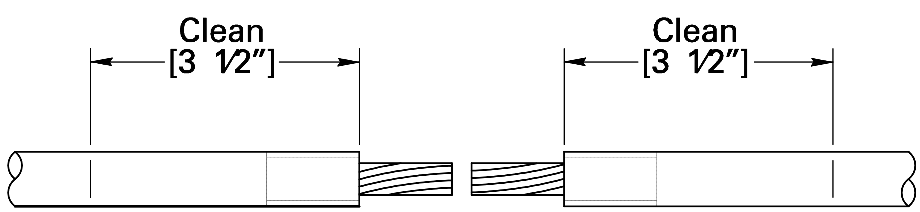


Figure 6

Note: If using "COLD SHRINK" method of splice recovering install tube at this time, before installing the splice. Park the tube on one side. Do not remove plastic liner.

Splice Installation: Select the proper splice for the conductor application from Table 6 below.

TABLE 6
Phase Conductor Splices
Full-Tension Compression Splices

CONDUCTORS TO BE SPLICED	CONDUCTOR "OD"	ITEM ID	SPLICE CAT. NO.	TOOL	DIE	TOTAL CRIMPS
1/0 6201 7-Str Std Round to 1/0 6201 7-Str Std Round	0.398"	9316636	Burndy YDS25RL Alcoa 7511 – 453	Y35 30A	U660 11AH	16
1/0 EC 7-Str Compact to 1/0 EC 7-Str Compact	0.338"	9316636	Burndy YDS25RL Alcoa 7511 – 453	Y35 30A	U660 11AH	16
1/0 EC 7-Str Compact to 1/0 6201 7-Str Standard Round	0.338 – 0.398"	9316636	Burndy YDS25RL Alcoa 7511 – 453	Y35 30A	U660 11AH	16
4/0 EC 7-Str Compact to 4/0 EC 7-Str Compact	0.478"	9311468	Burndy YDS28AT	Y35	U249	12
336.4 EC 19-Str Compact to 336.4 EC 19-Str Compact	0.607"	9315874	Burndy YDS301AT	Y35	U321	16
477 EC 19-Str Compact to 477 EC 19-Str Compact	0.722"	9311473	Burndy YDS331AT	Y35	U317	18
795 EC 37-Str Compact to 795 EC 37-Str Compact	0.932"	9312838[E]	Fargo C1511CD - 11	60T	11CD – 60	25% Overlap

TABLE 7
Phase Conductor Splices
Non-Tension Compression Reducing Splices

CONDUCTORS TO BE SPLICED	CONDUCTOR "OD"	ITEM ID	SPLICE CAT. NO.	TOOL	DIE	TOTAL CRIMPS
4/0 EC Compact to 477 EC Compact	0.478" – 0.722"	9312754[E]	Burndy YCR32RG3	Y35	U317	25% Overlap
336.4 EC Compact to 477 EC Compact	0.607" – 0.722"	9313010[E]	Burndy YCR32RG5	Y35	U317	25% Overlap

Install connector in accordance with manufacturer's instructions. Push conductor ends into splice body until fully inserted. Crimp using tools and dies shown in Tables 6 & 7. Remove excess oxide inhibitor and file off any sharp crimp flashings. Refer to Figure 7 below.

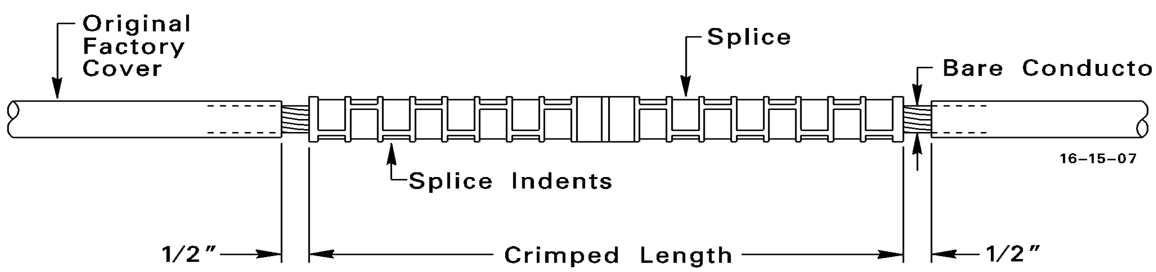


Figure 7

Supersedes 7/07 Issue – Revised Table 6 and 7 to include SAP Item ID #s

16.4.60 Phase Conductor Recovering

Application: There are three methods included in this Section for recovering spacer cable splices:

(1) COLD SHRINK, (2) HAND APPLIED TAPE AND (3) GELWRAP

NOTE: The Cold shrink is no longer available from the manufacturer (use up existing stock). The Hand Applied tape or Gel Wrap can be used on 15kV and below. The Hand Applied tape is the only option for above 15kV, up to 35kV.

New Construction 35 kV & Below: The preferred method is to use COLD SHRINK (Std. Item S16 fits all sizes except 1/0 15 kV).

Supersedes 1/06 Issue – Revised Crimping Detail On Figure 8

New Construction 15 kV & Below - 1/0: The preferred method is to use hand applied tape; however, gelwrap (Std. Item's C62 & C63) may also be used and shall be installed in accordance with manufacturer specifications.

A. Cold Shrink Method

1. **Apply Marker Tape** – Measure cold shrink body length and place marker tapes (adhesive side out) 2 inches away from each end of the centered cold shrink body. Refer to Figure 8 below.

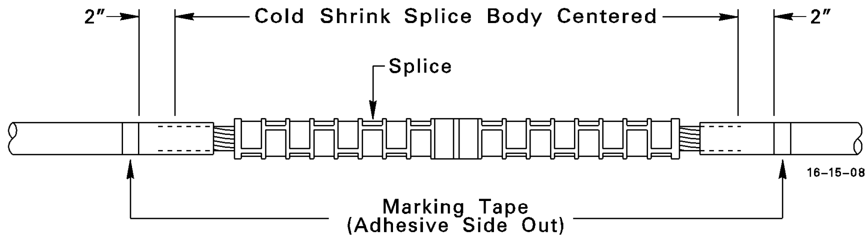


Figure 8

2. **Apply Silicone Grease** – Lubricate the entire surface of conductor covering from the marker tape(s) toward the crimped splice. Use the yellow tube of silicone grease supplied in the kit. Use foam pad under cap to spread grease. It is not necessary to apply grease over the connector.

3. **Slide Cold Shrink Body Into Position** – Remove the red factory tape securing the plastic cover. Unfold the plastic and slide the cold shrink body into the center of the splice area. The plastic liner will be left behind and can be removed at this point. Refer to Figure 9 below.

4.

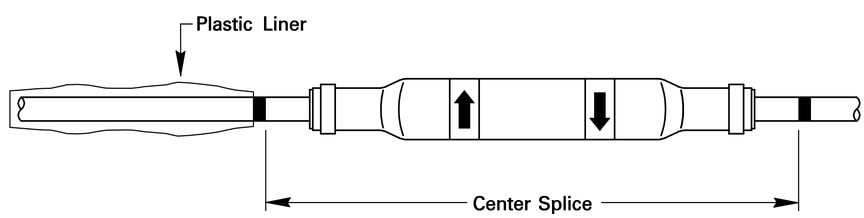


Figure 9

4. **Shrink the Body** – Steadily pull on the plastic cord, unwinding it around the conductor in the direction shown by the arrow on the cold shrink body. As the cord is pulled, it wraps around the conductor 1 or 2 times, and must be unwound before pulling again. Refer to the following, Figure 10.

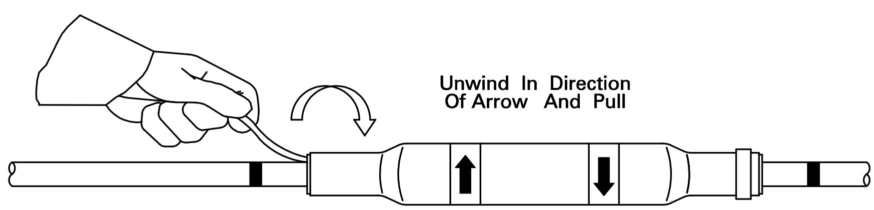


Figure 10

After shrinking the first 1-2 inches, the splice body should begin to grip the conductor. Re-center the body between marker tapes if necessary. Continue unwinding and pulling the cord until one side is completely shrunk. Refer to Figure 11 below.

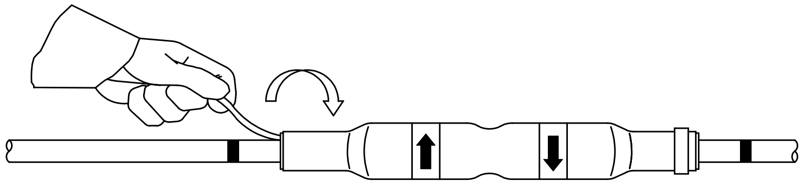


Figure 11

Repeat the shrinking process on the other side of the cold shrink splice body. Be sure to let the cord unwind in the direction indicated by the arrows. This completes the installation. Refer to Figure 12 below.

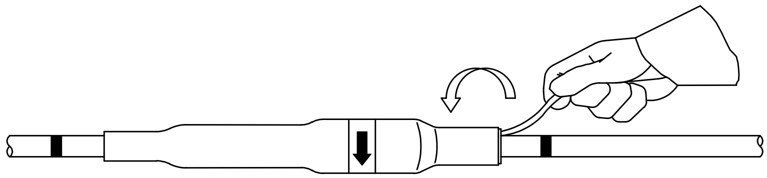


Figure 12

B. Hand Applied Tape Method

1. After filing off any sharp splice flashings, fill indents with filler compound, Std. Item T5E on the material list. Reference Figure 13 below.

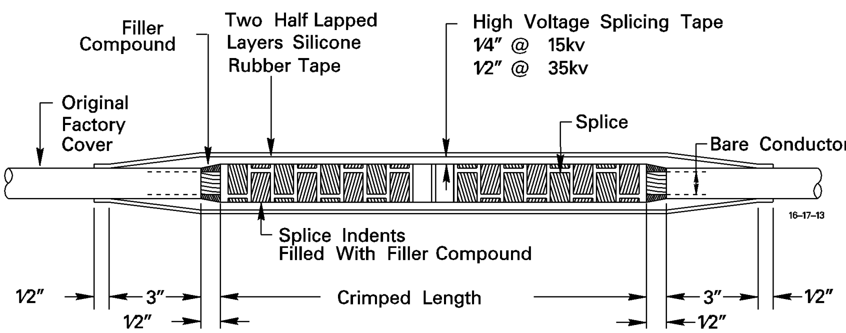


Figure 13

2. Apply ½ lap layer of high voltage splicing tape, Std. Item T5B, to the following thicknesses, over the connector and the outer conductor covering:
   15 kV - ¼ inch
   35 kV - ½ inch
   Taping to the above thickness is important in attempting to restore original factory insulation levels.

3. Cover the entire splice with two ½ lapped layers of silicone tape extending ½ inch beyond the high voltage splicing tape. Wrap tightly at both ends applying two additional turns of tape with only slight tension.

C. Gelwrap Method

Gelwrap kits are used to cover conductor splices or bare spots in the 15kV system. The kit consists of gray high dielectric filler mastic, gel filled plastic cover that snaps together and two plastic ties. Installation instructions provided by the manufacturer shall be followed.

Supersedes 7/07 Issue – Revised Gelwrap Method

Supersedes 1/06 Issue – Revised Section Numbering References Due to Reformatting

16.5 MESSENGER AND PHASE CONDUCTOR INSTALLATION

16.5.10 Preliminary

It is recommended that guying in accordance with individual Standards in this Section and Section 3-Guying be installed prior to pulling in the spacer cable messenger and phase conductors.
It is also recommended that tools, pulling blocks, hardware, procedures, and methods specified by Work Methods and Standards Engineering be employed to insure a properly installed system.

STEP 1: Pull messenger in place through stringing devices.

STEP 2: Refer to Messenger Initial Installation Sag & Tension Tables in this Standard for the appropriate messenger and phase conductors to be installed.

With one end of the messenger deadended, and using a dynamometer, tension the messenger in accordance with the following values for the ruling span involved and for the temperature at the time of installation. Sags are listed only for a visual check of the installation. (For ruling spans less than 150 feet, use installation tensions for 150 feet ruling span realizing that sags will be less.)

Once the appropriate tension has been reached, clamp messenger in place and remove messenger running blocks.

WARNING: Extreme care should be taken to see that the messenger has the correct initial installation tension. Low tension may result in excessive sags that do not comply with the NESC clearance requirements. Excessive initial tension may cause undue strain on the pole and on related hardware during storm loaded conditions (ice and wind).

STEP 3: After the messenger has been properly tensioned, pull all phase conductors in at the same time. Temporarily deadend both ends of the phase conductors.

STEP 4: Spacers should be installed at approximately 30 foot intervals between poles. They should be doubled at tangent brackets (one on each side of the bracket). First spans at locations where the phase conductors are spread out, such as at a crossarm deadend, should have double spacers placed approximately 50 feet out from the crossarm. Spacers should be placed out 30 feet from an E- or C-Bracket.

STEP 5: Spacer installation can begin by permanently deadending the phase conductors at one end and installing spacers, making sure that the phase conductor sag between spacers is as recommended in Table 8 on Page 16-19 and the corresponding illustration.

Alternately, spacer installation can begin in the middle of the run beginning at an E-Bracket where the phases can be tied to the insulators, and then spacers installed in both directions working toward the permanent deadend poles.

It will be necessary in most instances to pull slack ahead towards the ends of the conductors as the spacer installation and sagging process proceeds.

WARNING: Proper sagging between spacers is extremely important due to the different expansion rates of the messenger and the phase conductors. At below zero temperatures, the phase conductors can produce excessive forces on insulator pins causing bending. Also, phase conductors can cause spacer breakage. DO NOT OVER-TENSION PHASE CONDUCTORS DURING INSTALLATION.

Note: For spacer cable systems other than those depicted in these Standards, consult Standards Engineering (double circuit construction, larger messengers, larger phase conductors, longer spans, etc.).

Table 8
Phase Conductor Sags – 30 Foot Span Between Spacers

Temp. °F/˚C	20/-7	40/4.5	60/15.5	80/26.7	100/37.8	120/48.9	167/75
Sag In Inches	3	4	5	6	7	8	9

Supersedes 1/06 Issue – Page Content Shift / Change Due To Reformatting

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	*19500 lbs.	**TRANSVERSE**	3.0847 Lb/Ft	**SUMMER (37.7˚C)**	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
C.S.A.	*0.1785 sq. in.	**VERTICAL**	9.055 Lb/Ft			
R. (@ 25˚C)	0.0227 Ω / 1000’	**TOTAL**	9.866 Lb/Ft	669	**NORMAL**	952
R. (@ 75˚C)	0.0271 Ω / 1000’			828	**EMERGENCY**	1058
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	**SWING**	18.81˚			
MESSENGER DIAMETER	0.541”					
CONDUCTOR DIAMETER	1.572”					
SYSTEM WEIGHT	4466 lbs / 1000’					

Note: Quantities identified with an “ * “ are for the messenger only. All other quantities are specified for the complete spacer cable system.

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	2,325	1,722	1,380	1,052	1,150	863	688	526	574	481	437	398	423	390	371	352
ACTUAL SPAN (FEET)																
50	0.7	0.9	1.2	1.5	1.4	1.8	2.3	3.1	2.8	3.3	3.7	4.0	3.8	4.1	4.3	4.6
60	1.0	1.3	1.7	2.2	2.0	2.6	3.4	4.4	4.0	4.7	5.3	5.8	5.5	5.9	6.3	6.6
70	1.4	1.7	2.3	3.0	2.7	3.5	4.6	6.0	5.5	6.4	7.2	7.9	7.5	8.0	8.5	9.0
80	1.8	2.3	3.0	3.9	3.6	4.6	6.0	7.8	7.2	8.4	9.4	10.4	9.8	10.5	11.1	11.8
90	2.2	2.9	3.8	5.0	4.5	5.8	7.6	9.9	9.1	10.6	11.9	13.1	12.3	13.2	14.1	14.9
100	2.8	3.6	4.7	6.1	5.6	7.1	9.3	12.2	11.2	13.1	14.7	16.2	15.2	16.3	17.4	18.4
110	3.3	4.3	5.7	7.4	6.8	8.6	11.3	14.8	13.6	15.9	17.8	19.6	18.4	19.8	21.0	22.2
120	4.0	5.1	6.7	8.8	8.1	10.3	13.4	17.6	16.1	18.9	21.2	23.3	21.9	23.5	25.0	26.4
130	4.7	6.0	7.9	10.4	9.5	12.1	15.8	20.6	18.9	22.2	24.9	27.3	25.8	27.6	29.4	31.0
140	5.4	7.0	9.2	12.0	11.0	14.0	18.3	23.9	22.0	25.7	28.9	31.7	29.9	32.0	34.0	36.0
150	6.2	8.0	10.5	13.8	12.6	16.0	21.0	27.5	25.2	29.5	33.1	36.4	34.3	36.8	39.1	41.3
160	7.1	9.1	12.0	15.7	14.3	18.3	23.9	31.3	28.7	33.6	37.7	41.4	39.0	41.8	44.5	47.0
170	8.0	10.3	13.5	17.8	16.2	20.6	27.0	35.3	32.4	37.9	42.6	46.8	44.0	47.2	50.2	53.1
180	9.0	11.5	15.2	19.9	18.1	23.1	30.2	39.6	36.3	42.5	47.7	52.4	49.4	52.9	56.3	59.5
190	10.0	12.8	16.9	22.2	20.2	25.7	33.7	44.1	40.5	47.3	53.2	58.4	55.0	59.0	62.7	66.3
200	11.1	14.2	18.7	24.6	22.4	28.5	37.3	48.9	44.8	52.5	58.9	64.7	61.0	65.4	69.5	73.4
210	12.2	15.7	20.7	27.1	24.7	31.4	41.2	53.9	49.4	57.8	65.0	71.4	67.2	72.0	76.6	81.0
220	13.4	17.2	22.7	29.7	27.1	34.5	45.2	59.1	54.2	63.5	71.3	78.3	73.8	79.1	84.1	88.9
230	14.6	18.8	24.8	32.5	29.6	37.7	49.4	64.6	59.3	69.4	77.9	85.6	80.6	86.4	91.9	97.1
240	15.9	20.5	27.0	35.4	32.3	41.1	53.8	70.3	64.5	75.5	84.9	93.2	87.8	94.1	100.1	105.8
250	17.3	22.2	29.3	38.4	35.0	44.6	58.3	76.3	70.0	82.0	92.1	101.1	95.3	102.1	108.6	114.8
260	18.7	24.0	31.7	41.5	37.9	48.2	63.1	82.6	75.8	88.7	99.6	109.4	103.0	110.4	117.4	124.1
270	20.2	25.9	34.2	44.8	40.8	52.0	68.0	89.0	81.7	95.6	107.4	118.0	111.1	119.1	126.6	133.8
280	21.7	27.8	36.7	48.2	43.9	55.9	73.2	95.8	87.9	102.8	115.5	126.9	119.5	128.1	136.2	143.9
290	23.3	29.9	39.4	51.7	47.1	60.0	78.5	102.7	94.2	110.3	123.9	136.1	128.2	137.4	146.1	154.4
300	24.9	32.0	42.2	55.3	50.4	64.2	84.0	109.9	100.9	118.0	132.6	145.6	137.2	147.0	156.3	165.2

Supersedes 7/07 Issue – Revised Sag Tables

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	167	176	194
TEMP. ˚C	-18	0	15	32	50	75	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	2.8	3.1	3.6	4.2	5.0	6.6	7.0	7.8
75	7.0	7.9	9.0	10.3	11.9	14.4	14.9	16.0
100	14.3	16.0	17.9	19.8	21.8	25.1	25.7	26.9
125	25.6	28.0	30.4	32.6	35.0	38.6	39.4	40.7
150	40.9	43.6	46.2	48.8	51.4	55.2	55.9	57.4
175	59.8	62.6	65.4	68.2	70.8	74.8	75.6	77.0
200	82.1	85.0	87.8	90.6	93.2	97.4	98.3	99.8
225	107.6	110.5	113.4	116.2	118.9	123.2	124.0	125.6
250	136.3	139.3	142.2	145.1	147.8	152.2	153.0	154.6
275	168.4	171.4	174.2	177.1	179.9	184.3	185.0	186.7
300	203.8	206.6	209.5	212.4	215.3	219.6	220.4	222.1

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	6.0	5.8	4.1	*6,800
75	13.3	13.1	10.0	*6,800
100	23.8	23.4	19.2	*6,800
125	37.2	36.7	31.9	*6,800
150	53.6	53.2	47.9	*6,800
175	73.2	72.6	67.1	*6,800
200	95.8	95.2	89.5	*6,800
225	121.6	120.8	115.1	*6,800
250	150.4	149.8	143.9	*6,800
275	182.5	181.8	175.9	*6,800
300	217.9	217.2	211.2	*6,800
** Note: Design Specification Constraint*				

Supersedes 7/07 Issue – Revised Sag Tables

PHYSICAL PROPERTIES	
R.B.S.	*13800 lbs.
C.S.A.	*0.1450 sq. in.
R. (@ 25˚C)	0.0227 Ω / 1000'
R. (@ 75˚C)	0.0271 Ω / 1000'
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
MESSENGER DIAMETER	0.487"
CONDUCTOR DIAMETER	1.572"
SYSTEM WEIGHT	4351 lbs / 1000'

LOADING PROPERTIES	
TRANSVERSE	3.0691 Lb/Ft
VERTICAL	8.906 Lb/Ft
TOTAL	9.720 Lb/Ft
SWING	19.01˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
669	NORMAL	952
828	EMERGENCY	1058

Note: Quantities identified with an " * " are for the messenger only. All other quantities are specified for the complete spacer cable system.

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	2,479	1,897	1,547	1,178	1,661	1,221	981	760	754	563	451	379	390	345	321	298
ACTUAL SPAN (FEET)																
50	0.5	0.6	0.8	1.0	0.7	0.9	1.2	1.5	1.6	2.0	2.6	3.1	3.0	3.4	3.7	4.0
60	0.7	0.9	1.1	1.4	1.0	1.3	1.7	2.2	2.2	2.9	3.8	4.5	4.3	4.8	5.3	5.7
70	0.9	1.2	1.5	2.0	1.4	1.8	2.4	3.0	3.1	3.9	5.1	6.1	5.9	6.6	7.2	7.7
80	1.2	1.5	2.0	2.6	1.8	2.4	3.1	4.0	4.0	5.1	6.7	7.9	7.7	8.6	9.4	10.1
90	1.6	1.9	2.5	3.2	2.3	3.0	3.9	5.0	5.0	6.5	8.4	10.1	9.8	10.9	11.9	12.8
100	1.9	2.4	3.1	4.0	2.8	3.7	4.8	6.2	6.2	8.0	10.4	12.4	12.1	13.5	14.7	15.8
110	2.3	2.9	3.7	4.8	3.4	4.5	5.8	7.5	7.5	9.7	12.6	15.0	14.6	16.3	17.8	19.1
120	2.8	3.4	4.4	5.8	4.1	5.3	6.9	8.9	9.0	11.5	15.0	17.9	17.4	19.4	21.1	22.8
130	3.2	4.0	5.2	6.7	4.8	6.3	8.1	10.5	10.5	13.5	17.6	21.0	20.4	22.7	24.8	26.7
140	3.8	4.7	6.0	7.8	5.5	7.2	9.4	12.1	12.2	15.7	20.4	24.3	23.6	26.4	28.8	31.0
150	4.3	5.4	6.9	9.0	6.4	8.3	10.8	13.9	14.0	18.0	23.5	27.9	27.1	30.3	33.0	35.6
160	4.9	6.1	7.9	10.2	7.2	9.5	12.3	15.8	15.9	20.5	26.7	31.8	30.9	34.5	37.6	40.5
170	5.5	6.9	8.9	11.5	8.2	10.7	13.9	17.9	18.0	23.1	30.1	35.9	34.9	38.9	42.4	45.7
180	6.2	7.8	10.0	12.9	9.2	12.0	15.6	20.0	20.2	25.9	33.8	40.2	39.1	43.6	47.5	51.2
190	6.9	8.6	11.1	14.4	10.2	13.4	17.3	22.3	22.5	28.9	37.6	44.8	43.5	48.6	53.0	57.1
200	7.7	9.6	12.3	16.0	11.3	14.8	19.2	24.7	24.9	32.0	41.7	49.7	48.2	53.8	58.7	63.2
210	8.5	10.6	13.5	17.6	12.5	16.3	21.2	27.3	27.5	35.3	46.0	54.8	53.2	59.4	64.7	69.7
220	9.3	11.6	14.9	19.3	13.7	17.9	23.2	29.9	30.2	38.7	50.4	60.1	58.4	65.1	71.0	76.5
230	10.2	12.7	16.3	21.1	15.0	19.6	25.4	32.7	33.0	42.3	55.1	65.7	63.8	71.2	77.6	83.6
240	11.1	13.8	17.7	23.0	16.3	21.3	27.6	35.6	35.9	46.1	60.0	71.5	69.5	77.5	84.5	91.1
250	12.0	15.0	19.2	25.0	17.7	23.1	30.0	38.7	38.9	50.0	65.1	77.6	75.4	84.1	91.7	98.8
260	13.0	16.2	20.8	27.0	19.1	25.0	32.4	41.8	42.1	54.0	70.5	84.0	81.5	91.0	99.2	106.9
270	14.0	17.4	22.4	29.1	20.6	27.0	35.0	45.1	45.4	58.3	76.0	90.6	87.9	98.1	106.9	115.3
280	15.1	18.8	24.1	31.3	22.2	29.0	37.6	48.5	48.8	62.7	81.7	97.4	94.6	105.5	115.0	124.0
290	16.1	20.1	25.8	33.6	23.8	31.1	40.4	52.0	52.4	67.2	87.7	104.5	101.4	113.2	123.4	133.0
300	17.3	21.5	27.6	35.9	25.4	33.3	43.2	55.7	56.1	72.0	93.8	111.8	108.5	121.1	132.0	142.3

Supersedes 7/07 Issue – Revised Sag Tables

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	167	176	194
TEMP. ˚C	-18	0	15	32	50	75	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	3.6	4.1	4.7	5.5	6.5	8.3	8.6	9.4
75	8.4	9.5	10.7	12.0	13.6	16.0	16.4	17.4
100	15.5	17.2	19.0	20.8	22.7	25.8	26.3	27.5
125	25.3	27.4	29.6	31.9	34.1	37.6	38.3	39.6
150	37.7	40.2	42.7	45.2	47.8	51.6	52.3	53.8
175	55.8	58.6	61.3	64.1	66.7	70.8	71.5	73.1
200	77.5	80.4	83.3	86.0	88.8	93.0	93.8	95.4
225	102.5	105.5	108.4	111.2	114.0	118.3	119.2	120.7
250	130.8	133.8	136.7	139.6	142.4	146.8	147.6	149.3
275	162.2	165.2	168.2	171.1	174.0	178.4	179.3	180.8
300	197.0	200.0	203.0	205.9	208.8	213.2	214.1	215.8

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	7.4	7.2	5.3	5,373
75	15.5	15.0	11.8	5,807
100	25.8	25.1	20.4	6,194
125	38.3	37.3	31.4	6,524
150	52.9	51.7	44.8	*6,800
175	72.2	70.8	63.5	*6,800
200	94.4	93.0	85.4	*6,800
225	119.9	118.3	110.5	*6,800
250	148.3	146.8	138.8	*6,800
275	180.0	178.3	170.4	*6,800
300	214.8	213.2	205.2	*6,800
** Note: Design Specification Constraint*				

Supersedes 7/07 Issue – Revised Sag Tables

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	*19500 lbs.	TRANSVERSE	2.8078 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	*0.1785 sq. in.	VERTICAL	7.716 Lb/Ft			
R. (@ 25˚C)	0.0227 Ω / 1000’	TOTAL	8.511 Lb/Ft	714	NORMAL	1005
R. (@ 75˚C)	0.0271 Ω / 1000’			881	EMERGENCY	1118
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	20.00˚			
MESSENGER DIAMETER	0.541”					
CONDUCTOR DIAMETER	1.292”					
SYSTEM WEIGHT	3658 lbs / 1000’					

Note: Quantities identified with an “ * “ are for the messenger only. All other quantities are specified for the complete spacer cable system.

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	3,241	2,506	2,060	1,585	2,010	1,487	1,203	945	1,102	858	714	572	659	551	501	455
ACTUAL SPAN (FEET)																
50	0.5	0.6	0.8	1.0	0.8	1.0	1.3	1.7	1.5	1.8	2.3	2.8	2.4	2.9	3.2	3.5
60	0.7	0.9	1.1	1.5	1.2	1.5	1.9	2.4	2.1	2.6	3.2	4.0	3.5	4.1	4.6	5.1
70	1.0	1.2	1.5	2.0	1.6	2.0	2.6	3.3	2.9	3.5	4.4	5.5	4.8	5.6	6.3	6.9
80	1.3	1.6	2.0	2.6	2.0	2.6	3.4	4.3	3.7	4.6	5.8	7.2	6.2	7.3	8.2	9.0
90	1.6	2.0	2.6	3.3	2.6	3.3	4.3	5.5	4.7	5.8	7.3	9.1	7.9	9.3	10.4	11.4
100	2.0	2.5	3.1	4.1	3.2	4.1	5.3	6.8	5.8	7.2	9.0	11.2	9.8	11.4	12.8	14.1
110	2.4	3.0	3.8	4.9	3.9	5.0	6.5	8.2	7.1	8.7	10.9	13.6	11.8	13.8	15.5	17.1
120	2.9	3.6	4.5	5.9	4.6	5.9	7.7	9.8	8.4	10.4	13.0	16.2	14.0	16.5	18.5	20.3
130	3.4	4.2	5.3	6.9	5.4	7.0	9.0	11.4	9.9	12.2	15.2	19.0	16.5	19.3	21.7	23.9
140	3.9	4.8	6.2	8.0	6.3	8.1	10.5	13.3	11.4	14.1	17.7	22.0	19.1	22.4	25.2	27.7
150	4.5	5.6	7.1	9.2	7.2	9.3	12.0	15.2	13.1	16.2	20.3	25.3	21.9	25.7	28.9	31.8
160	5.1	6.3	8.1	10.4	8.2	10.6	13.7	17.3	14.9	18.4	23.1	28.8	25.0	29.2	32.9	36.2
170	5.8	7.1	9.1	11.8	9.2	11.9	15.4	19.6	16.9	20.8	26.0	32.5	28.2	33.0	37.1	40.8
180	6.5	8.0	10.2	13.2	10.4	13.4	17.3	21.9	18.9	23.3	29.2	36.4	31.6	37.0	41.6	45.8
190	7.2	8.9	11.4	14.7	11.6	14.9	19.3	24.5	21.1	26.0	32.5	40.6	35.2	41.2	46.4	51.0
200	8.0	9.9	12.6	16.3	12.8	16.5	21.3	27.1	23.4	28.8	36.0	45.0	39.0	45.7	51.4	56.5
210	8.8	10.9	13.9	18.0	14.1	18.2	23.5	29.9	25.7	31.8	39.7	49.6	43.0	50.4	56.6	62.3
220	9.7	12.0	15.2	19.7	15.5	20.0	25.8	32.8	28.3	34.9	43.6	54.4	47.2	55.3	62.1	68.4
230	10.6	13.1	16.7	21.5	16.9	21.8	28.2	35.8	30.9	38.1	47.7	59.5	51.6	60.4	67.9	74.7
240	11.5	14.2	18.1	23.4	18.4	23.8	30.7	39.0	33.6	41.5	51.9	64.8	56.2	65.8	74.0	81.4
250	12.5	15.4	19.7	25.4	20.0	25.8	33.3	42.3	36.5	45.0	56.3	70.3	60.9	71.4	80.3	88.3
260	13.5	16.7	21.3	27.5	21.6	27.9	36.1	45.8	39.5	48.7	60.9	76.0	65.9	77.2	86.8	95.5
270	14.6	18.0	23.0	29.7	23.3	30.1	38.9	49.4	42.6	52.5	65.7	82.0	71.1	83.3	93.6	103.0
280	15.7	19.4	24.7	31.9	25.1	32.4	41.8	53.1	45.8	56.5	70.7	88.2	76.4	89.6	100.7	110.8
290	16.8	20.8	26.5	34.2	26.9	34.7	44.9	57.0	49.1	60.6	75.8	94.6	82.0	96.1	108.0	118.8
300	18.0	22.2	28.3	36.6	28.8	37.1	48.0	61.0	52.5	64.8	81.1	101.2	87.8	102.8	115.6	127.2

Supersedes 7/07 Issue – Revised Sag Tables

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**167**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**75**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	2.2	2.5	2.9	3.4	4.1	5.6	6.0	6.7
75	5.4	6.2	7.2	8.4	9.8	12.4	13.0	14.0
100	11.0	12.5	14.3	16.2	18.2	21.7	22.3	23.6
125	19.8	22.1	24.5	27.0	29.6	33.5	34.3	35.8
150	32.3	35.2	38.0	40.9	43.7	48.0	48.8	50.4
175	48.2	51.4	54.5	57.6	60.5	65.0	65.9	67.6
200	67.3	70.7	73.8	77.0	80.0	84.7	85.7	87.4
225	89.4	92.8	96.0	99.2	102.4	107.2	108.1	109.9
250	114.4	117.7	121.0	124.2	127.4	132.4	133.2	135.0
275	142.1	145.4	148.8	152.0	155.3	160.2	161.2	163.0
300	172.7	176.0	179.4	182.6	185.9	190.9	191.8	193.7

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			**TENSION (LBS.)**
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	5.2	4.9	3.4	*6,800
75	11.6	11.2	8.0	*6,800
100	20.8	20.0	15.6	*6,800
125	32.5	31.7	26.3	*6,800
150	46.9	45.8	39.8	*6,800
175	63.8	62.8	56.4	*6,800
200	83.5	82.3	75.8	*6,800
225	106.0	104.6	97.9	*6,800
250	131.0	129.7	122.9	*6,800
275	158.9	157.6	150.7	*6,800
300	189.6	188.3	181.3	*6,800
** Note: Design Specification Constraint*				

Supersedes 7/07 Issue – Revised Sag Tables

PHYSICAL PROPERTIES	
R.B.S.	*13800 lbs.
C.S.A.	*0.1450 sq. in.
R. (@ 25˚C)	0.0227 Ω / 1000’
R. (@ 75˚C)	0.0271 Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
MESSENGER DIAMETER	0.487”
CONDUCTOR DIAMETER	1.292”
SYSTEM WEIGHT	3543 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	2.7874 Lb/Ft
VERTICAL	7.568 Lb/Ft
TOTAL	8.365 Lb/Ft
SWING	20.22˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
714	NORMAL	1005
881	EMERGENCY	1118

Note: Quantities identified with an “ * “ are for the messenger only. All other quantities are specified for the complete spacer cable system.

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	3,220	2,564	2,154	1,695	2,592	2,002	1,646	1,269	1,551	1,150	936	743	806	638	523	438
ACTUAL SPAN (FEET)																
50	0.4	0.4	0.5	0.7	0.5	0.6	0.7	0.9	0.8	1.0	1.3	1.6	1.5	1.8	2.2	2.7
60	0.5	0.6	0.8	1.0	0.7	0.8	1.0	1.3	1.1	1.4	1.8	2.3	2.1	2.5	3.2	3.9
70	0.7	0.9	1.1	1.4	0.9	1.1	1.4	1.8	1.5	1.9	2.5	3.1	2.9	3.5	4.4	5.3
80	0.9	1.1	1.4	1.8	1.2	1.4	1.8	2.4	1.9	2.5	3.2	4.0	3.7	4.5	5.7	6.9
90	1.2	1.4	1.7	2.2	1.5	1.8	2.3	3.0	2.4	3.2	4.1	5.1	4.7	5.7	7.3	8.7
100	1.5	1.8	2.2	2.8	1.8	2.2	2.8	3.7	3.0	3.9	5.0	6.3	5.8	7.1	9.0	10.7
110	1.8	2.1	2.6	3.3	2.2	2.7	3.4	4.5	3.7	4.8	6.1	7.6	7.0	8.6	10.9	13.0
120	2.1	2.6	3.1	4.0	2.6	3.2	4.1	5.3	4.3	5.7	7.2	9.1	8.4	10.2	12.9	15.5
130	2.5	3.0	3.6	4.7	3.1	3.8	4.8	6.2	5.1	6.7	8.5	10.7	9.8	12.0	15.2	18.2
140	2.9	3.5	4.2	5.4	3.6	4.4	5.5	7.2	5.9	7.7	9.8	12.4	11.4	13.9	17.6	21.1
150	3.3	4.0	4.8	6.2	4.1	5.1	6.4	8.3	6.8	8.9	11.3	14.2	13.1	15.9	20.2	24.2
160	3.7	4.5	5.5	7.1	4.6	5.8	7.2	9.4	7.7	10.1	12.8	16.1	14.9	18.1	23.0	27.5
170	4.2	5.1	6.2	8.0	5.2	6.5	8.2	10.6	8.7	11.4	14.5	18.2	16.8	20.5	25.9	31.0
180	4.7	5.7	7.0	9.0	5.9	7.3	9.2	11.9	9.8	12.8	16.3	20.4	18.9	22.9	29.1	34.8
190	5.3	6.4	7.8	10.0	6.5	8.1	10.2	13.3	10.9	14.2	18.1	22.8	21.0	25.6	32.4	38.8
200	5.8	7.1	8.6	11.1	7.3	9.0	11.3	14.7	12.1	15.7	20.1	25.2	23.3	28.3	35.9	43.0
210	6.4	7.8	9.5	12.2	8.0	9.9	12.5	16.2	13.3	17.4	22.1	27.8	25.7	31.2	39.6	47.4
220	7.1	8.6	10.4	13.4	8.8	10.9	13.7	17.8	14.6	19.1	24.3	30.5	28.2	34.3	43.4	52.0
230	7.7	9.4	11.4	14.6	9.6	11.9	15.0	19.5	16.0	20.8	26.5	33.4	30.8	37.5	47.5	56.8
240	8.4	10.2	12.4	15.9	10.4	13.0	16.3	21.2	17.4	22.7	28.9	36.3	33.5	40.8	51.7	61.9
250	9.1	11.1	13.4	17.3	11.3	14.1	17.7	23.0	18.9	24.6	31.3	39.4	36.4	44.3	56.1	67.1
260	9.9	12.0	14.5	18.7	12.3	15.2	19.1	24.9	20.4	26.6	33.9	42.6	39.3	47.9	60.6	72.6
270	10.6	12.9	15.7	20.2	13.2	16.4	20.6	26.8	22.0	28.7	36.6	46.0	42.4	51.6	65.4	78.3
280	11.4	13.9	16.9	21.7	14.2	17.6	22.2	28.9	23.7	30.9	39.3	49.5	45.6	55.5	70.3	84.2
290	12.3	14.9	18.1	23.3	15.3	18.9	23.8	30.9	25.4	33.1	42.2	53.1	48.9	59.6	75.4	90.3
300	13.1	16.0	19.4	24.9	16.3	20.2	25.4	33.1	27.2	35.4	45.1	56.8	52.4	63.7	80.7	96.7

Supersedes 7/07 Issue – Revised Sag Tables

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	167	176	194
TEMP. ˚C	-18	0	15	32	50	75	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	2.9	3.2	3.8	4.6	5.5	7.3	7.7	8.4
75	6.6	7.6	8.6	10.0	11.5	14.0	14.5	15.6
100	12.2	13.7	15.4	17.3	19.2	22.4	23.0	24.4
125	19.8	21.8	24.1	26.4	28.8	32.5	33.2	34.7
150	29.5	32.0	34.7	37.4	40.2	44.4	45.1	46.8
175	44.0	47.0	50.0	53.0	55.9	60.5	61.3	63.0
200	62.3	65.5	68.8	71.9	75.0	79.8	80.6	82.4
225	83.8	87.1	90.4	93.6	96.8	101.8	102.6	104.4
250	108.1	111.5	114.8	118.2	121.4	126.4	127.3	129.1
275	135.2	138.7	142.1	145.4	148.7	153.7	154.7	156.6
300	165.2	168.7	172.1	175.4	178.8	183.8	184.8	186.7

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	6.6	6.2	4.4	5,292
75	13.7	13.1	9.7	5,704
100	22.8	21.8	16.9	6,094
125	33.8	32.4	26.0	6,443
150	46.4	44.8	37.1	6,750
175	62.9	61.0	52.4	*6,800
200	82.2	80.2	71.3	*6,800
225	104.3	102.0	92.9	*6,800
250	129.0	126.6	117.4	*6,800
275	156.4	154.0	144.6	*6,800
300	186.6	184.1	174.6	*6,800
** Note: Design Specification Constraint*				

Supersedes 7/07 Issue – Revised Sag Tables

PHYSICAL PROPERTIES	
R.B.S.	*19500 lbs.
C.S.A.	*0.1785 sq. in.
R. (@ 25˚C)	0.0373 Ω / 1000'
R. (@ 75˚C)	0.0447 Ω / 1000'
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
MESSENGER DIAMETER	0.541"
CONDUCTOR DIAMETER	1.362"
SYSTEM WEIGHT	3230 lbs / 1000'

LOADING PROPERTIES	
TRANSVERSE	2.8749 Lb/Ft
VERTICAL	7.427 Lb/Ft
TOTAL	8.264 Lb/Ft
SWING	21.16˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
489	NORMAL	692
603	EMERGENCY	768

Note: Quantities identified with an " * " are for the messenger only. All other quantities are specified for the complete spacer cable system.

Supersedes 7/07 Issue – Revised Sag Tables

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	3,407	2,653	2,193	1,696	2,196	1,633	1,321	1,028	1,236	953	815	631	755	605	539	484
ACTUAL SPAN (FEET)																
50	0.5	0.6	0.7	0.9	0.7	0.9	1.2	1.6	1.3	1.6	2.0	2.5	2.1	2.6	3.0	3.3
60	0.7	0.8	1.1	1.4	1.1	1.4	1.7	2.2	1.9	2.3	2.8	3.7	3.1	3.7	4.3	4.8
70	0.9	1.1	1.4	1.8	1.4	1.8	2.4	3.1	2.6	3.2	3.9	5.0	4.2	5.1	5.9	6.5
80	1.2	1.5	1.9	2.4	1.9	2.4	3.1	4.0	3.3	4.2	5.0	6.5	5.5	6.6	7.6	8.5
90	1.6	1.9	2.4	3.0	2.4	3.0	3.9	5.1	4.2	5.3	6.4	8.3	6.9	8.4	9.7	10.8
100	1.9	2.3	2.9	3.8	2.9	3.8	4.9	6.2	5.2	6.5	7.9	10.2	8.5	10.4	11.9	13.3
110	2.3	2.8	3.5	4.6	3.5	4.5	5.9	7.6	6.3	7.9	9.5	12.3	10.3	12.6	14.4	16.1
120	2.8	3.3	4.2	5.4	4.2	5.4	7.0	9.0	7.5	9.4	11.3	14.7	12.3	14.9	17.2	19.2
130	3.2	3.9	4.9	6.4	5.0	6.3	8.2	10.5	8.8	11.0	13.3	17.2	14.4	17.5	20.2	22.5
140	3.8	4.5	5.7	7.4	5.7	7.4	9.5	12.2	10.2	12.8	15.4	20.0	16.7	20.3	23.4	26.1
150	4.3	5.2	6.6	8.5	6.6	8.4	10.9	14.0	11.7	14.7	17.7	22.9	19.2	23.3	26.9	30.0
160	4.9	5.9	7.5	9.6	7.5	9.6	12.4	16.0	13.3	16.7	20.2	26.1	21.8	26.6	30.6	34.1
170	5.5	6.7	8.4	10.9	8.5	10.8	14.0	18.0	15.1	18.9	22.8	29.4	24.6	30.0	34.5	38.5
180	6.2	7.5	9.5	12.2	9.5	12.2	15.7	20.2	16.9	21.1	25.5	33.0	27.6	33.6	38.7	43.2
190	6.9	8.4	10.5	13.6	10.6	13.5	17.5	22.5	18.8	23.6	28.4	36.8	30.8	37.5	43.1	48.1
200	7.7	9.3	11.7	15.1	11.7	15.0	19.4	25.0	20.8	26.1	31.5	40.8	34.1	41.5	47.8	53.3
210	8.5	10.2	12.9	16.6	12.9	16.5	21.4	27.5	23.0	28.8	34.7	44.9	37.6	45.8	52.7	58.7
220	9.3	11.2	14.1	18.2	14.2	18.2	23.5	30.2	25.2	31.6	38.1	49.3	41.2	50.2	57.8	64.5
230	10.2	12.2	15.4	19.9	15.5	19.8	25.7	33.0	27.6	34.5	41.7	53.9	45.1	54.9	63.2	70.5
240	11.1	13.3	16.8	21.7	16.9	21.6	28.0	35.9	30.0	37.6	45.4	58.7	49.1	59.8	68.8	76.7
250	12.0	14.5	18.2	23.5	18.3	23.5	30.3	39.0	32.6	40.8	49.2	63.7	53.3	64.9	74.6	83.3
260	13.0	15.6	19.7	25.4	19.8	25.4	32.8	42.2	35.2	44.1	53.2	68.9	57.6	70.1	80.7	90.0
270	14.0	16.9	21.3	27.4	21.4	27.4	35.4	45.5	38.0	47.6	57.4	74.3	62.1	75.6	87.0	97.1
280	15.1	18.1	22.9	29.5	23.0	29.4	38.1	48.9	40.9	51.2	61.7	79.9	66.8	81.4	93.6	104.4
290	16.1	19.5	24.5	31.6	24.7	31.6	40.8	52.5	43.8	54.9	66.2	85.7	71.7	87.3	100.4	112.0
300	17.3	20.8	26.3	33.9	26.4	33.8	43.7	56.2	46.9	58.7	70.9	91.7	76.7	93.4	107.5	119.9

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	167	176	194
TEMP. ˚C	-18	0	15	32	50	75	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.9	2.2	2.5	3.0	3.7	5.2	5.5	6.4
75	4.8	5.5	6.4	7.6	8.9	11.5	12.1	13.2
100	9.7	11.2	12.8	14.8	16.9	20.5	21.1	22.6
125	17.8	20.0	22.6	25.2	27.8	31.9	32.8	34.2
150	29.5	32.5	35.5	38.5	41.4	46.0	46.8	48.5
175	44.9	48.2	51.5	54.7	57.8	62.5	63.4	65.2
200	63.5	67.0	70.3	73.6	76.8	81.7	82.6	84.4
225	85.0	88.4	91.8	95.2	98.5	103.4	104.4	106.2
250	109.2	112.7	116.2	119.5	122.9	127.9	128.9	130.7
275	136.2	139.7	143.2	146.5	149.9	155.0	156.0	157.9
300	166.0	169.4	172.9	176.3	179.6	184.8	185.8	187.7

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	5.0	4.8	3.1	*6,800
75	11.4	10.8	7.6	*6,800
100	20.3	19.4	14.6	*6,800
125	31.7	30.6	24.8	*6,800
150	45.6	44.4	37.9	*6,800
175	62.2	60.8	54.0	*6,800
200	81.4	79.9	72.8	*6,800
225	103.1	101.6	94.3	*6,800
250	127.6	126.0	118.7	*6,800
275	154.7	153.1	145.7	*6,800
300	184.4	182.9	175.3	*6,800
** Note: Design Specification Constraint*				

Supersedes 7/07 Issue – Revised Sag Tables

PHYSICAL PROPERTIES	
R.B.S.	*13800 lbs.
C.S.A.	*0.1450 sq. in.
R. (@ 25˚C)	0.0373 Ω / 1000’
R. (@ 75˚C)	0.0447 Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
MESSENGER DIAMETER	0.487”
CONDUCTOR DIAMETER	1.362”
SYSTEM WEIGHT	3115 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	2.8579 Lb/Ft
VERTICAL	7.278 Lb/Ft
TOTAL	8.119 Lb/Ft
SWING	21.44˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
489	NORMAL	692
603	EMERGENCY	768

Note: Quantities identified with an “ * “ are for the messenger only. All other quantities are specified for the complete spacer cable system.

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	3,576	2,893	2,463	1,970	2,881	2,259	1,878	1,463	1,748	1,302	1,056	829	925	723	615	487
ACTUAL SPAN (FEET)																
50	0.3	0.4	0.5	0.6	0.4	0.5	0.6	0.8	0.7	0.9	1.1	1.4	1.3	1.6	1.9	2.4
60	0.5	0.6	0.7	0.9	0.6	0.7	0.9	1.2	1.0	1.2	1.6	2.0	1.8	2.3	2.8	3.5
70	0.6	0.8	0.9	1.2	0.8	1.0	1.2	1.6	1.3	1.7	2.2	2.8	2.5	3.1	3.7	4.7
80	0.8	1.0	1.2	1.5	1.1	1.3	1.6	2.0	1.7	2.2	2.8	3.6	3.2	4.0	4.9	6.2
90	1.1	1.2	1.6	1.9	1.3	1.6	2.0	2.6	2.2	2.8	3.6	4.6	4.1	5.1	6.2	7.8
100	1.3	1.5	1.9	2.4	1.7	2.0	2.5	3.2	2.7	3.5	4.4	5.7	5.1	6.3	7.7	9.7
110	1.6	1.9	2.3	2.9	2.0	2.4	3.0	3.9	3.3	4.2	5.4	6.9	6.1	7.6	9.3	11.7
120	1.9	2.2	2.8	3.4	2.4	2.9	3.6	4.6	3.9	5.0	6.4	8.2	7.3	9.1	11.0	13.9
130	2.2	2.6	3.2	4.0	2.8	3.3	4.2	5.4	4.6	5.9	7.5	9.6	8.6	10.6	12.9	16.3
140	2.6	3.0	3.8	4.7	3.2	3.9	4.9	6.3	5.3	6.8	8.7	11.1	9.9	12.3	15.0	18.9
150	2.9	3.5	4.3	5.4	3.7	4.5	5.6	7.2	6.1	7.8	10.0	12.8	11.4	14.2	17.2	21.7
160	3.3	3.9	4.9	6.1	4.2	5.1	6.4	8.2	6.9	8.9	11.3	14.5	13.0	16.1	19.6	24.7
170	3.8	4.5	5.5	6.9	4.8	5.7	7.2	9.2	7.8	10.0	12.8	16.4	14.7	18.2	22.1	27.9
180	4.2	5.0	6.2	7.7	5.4	6.4	8.1	10.4	8.8	11.2	14.3	18.4	16.4	20.4	24.8	31.3
190	4.7	5.6	6.9	8.6	6.0	7.2	9.0	11.6	9.8	12.5	16.0	20.5	18.3	22.7	27.6	34.9
200	5.2	6.2	7.7	9.5	6.6	7.9	10.0	12.8	10.8	13.9	17.7	22.7	20.3	25.2	30.6	38.6
210	5.8	6.8	8.5	10.5	7.3	8.7	11.1	14.1	11.9	15.3	19.5	25.1	22.4	27.8	33.7	42.6
220	6.3	7.5	9.3	11.5	8.0	9.6	12.1	15.5	13.1	16.8	21.4	27.5	24.5	30.5	37.0	46.8
230	6.9	8.2	10.2	12.6	8.7	10.5	13.3	16.9	14.3	18.3	23.4	30.1	26.8	33.3	40.5	51.1
240	7.5	8.9	11.1	13.7	9.5	11.4	14.4	18.4	15.6	20.0	25.5	32.7	29.2	36.2	44.1	55.6
250	8.2	9.6	12.0	14.9	10.3	12.4	15.7	20.0	16.9	21.7	27.7	35.5	31.7	39.3	47.8	60.4
260	8.8	10.4	13.0	16.1	11.2	13.4	16.9	21.6	18.3	23.4	29.9	38.4	34.3	42.5	51.7	65.3
270	9.5	11.2	14.0	17.4	12.1	14.5	18.3	23.3	19.7	25.3	32.3	41.4	37.0	45.9	55.8	70.4
280	10.2	12.1	15.1	18.7	13.0	15.5	19.7	25.1	21.2	27.2	34.7	44.5	39.7	49.3	60.0	75.7
290	11.0	13.0	16.1	20.0	13.9	16.7	21.1	26.9	22.7	29.1	37.2	47.8	42.6	52.9	64.3	81.2
300	11.8	13.9	17.3	21.4	14.9	17.8	22.6	28.8	24.3	31.2	39.8	51.1	45.6	56.6	68.9	86.9

Supersedes 7/07 Issue – Revised Sag Tables

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	167	176	194
TEMP. ˚C	-18	0	15	32	50	75	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	2.5	2.9	3.4	4.1	4.9	6.7	7.1	7.9
75	5.8	6.6	7.7	8.9	10.3	13.0	13.4	14.5
100	10.6	12.0	13.6	15.4	17.4	20.6	21.4	22.7
125	17.0	19.0	21.2	23.5	25.9	29.9	30.6	32.2
150	26.2	28.8	31.4	34.2	37.1	41.5	42.4	44.0
175	40.3	43.4	46.6	49.7	52.8	57.6	58.4	60.2
200	58.0	61.4	64.8	68.0	71.3	76.3	77.2	79.1
225	78.7	82.3	85.8	89.2	92.5	97.6	98.5	100.4
250	102.5	106.1	109.6	113.0	116.4	121.6	122.5	124.4
275	128.9	132.5	136.1	139.4	142.9	148.2	149.2	151.1
300	158.0	161.6	165.2	168.7	172.2	177.4	178.4	180.4

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	6.4	6.0	4.1	5,308
75	13.3	12.6	9.0	5,744
100	22.0	20.9	15.6	6,166
125	32.4	30.7	23.9	6,553
150	44.9	43.0	34.6	*6,800
175	61.2	59.0	49.9	*6,800
200	80.0	77.6	68.2	*6,800
225	101.5	98.9	89.2	*6,800
250	125.5	122.9	112.8	*6,800
275	152.2	149.4	139.3	*6,800
300	181.4	178.7	168.5	*6,800
Note: Design Specification Constraint				

Supersedes 7/07 Issue – Revised Sag Tables

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	*19500 lbs.	TRANSVERSE	2.5544 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	*0.1785 sq. in.	VERTICAL	6.014 Lb/Ft			
R. (@ 25˚C)	0.0373 Ω / 1000'	TOTAL	6.834 Lb/Ft	528	NORMAL	739
R. (@ 75˚C)	0.0447 Ω / 1000'			647	EMERGENCY	819
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	23.01˚			
MESSENGER DIAMETER	0.541"					
CONDUCTOR DIAMETER	1.042"					
SYSTEM WEIGHT	2422 lbs / 1000'					

Note: Quantities identified with an " * " are for the messenger only. All other quantities are specified for the complete spacer cable system.

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	4,329	3,496	2,971	2,373	3,340	2,601	2,153	1,675	2,330	1,756	1,435	1,131	1,486	1,145	974	821
ACTUAL SPAN (FEET)																
50	0.4	0.4	0.5	0.7	0.5	0.6	0.7	1.0	0.7	0.9	1.1	1.4	1.1	1.4	1.7	2.0
60	0.5	0.6	0.8	1.0	0.7	0.8	1.1	1.4	1.0	1.3	1.6	2.0	1.6	2.0	2.4	2.8
70	0.7	0.9	1.1	1.3	0.9	1.2	1.5	1.9	1.3	1.7	2.2	2.8	2.1	2.7	3.2	3.8
80	0.9	1.1	1.4	1.7	1.2	1.5	1.9	2.5	1.8	2.2	2.9	3.6	2.8	3.5	4.2	5.0
90	1.2	1.4	1.7	2.2	1.6	1.9	2.4	3.1	2.2	2.8	3.6	4.6	3.5	4.4	5.3	6.3
100	1.5	1.8	2.2	2.7	1.9	2.4	3.0	3.8	2.7	3.5	4.5	5.7	4.3	5.4	6.6	7.8
110	1.8	2.1	2.6	3.3	2.3	2.9	3.6	4.6	3.3	4.2	5.4	6.9	5.2	6.6	8.0	9.5
120	2.1	2.6	3.1	3.9	2.8	3.4	4.3	5.5	3.9	5.0	6.4	8.2	6.2	7.8	9.5	11.3
130	2.5	3.0	3.6	4.5	3.2	4.0	5.0	6.5	4.6	5.9	7.5	9.6	7.3	9.2	11.2	13.2
140	2.9	3.5	4.2	5.3	3.8	4.6	5.9	7.5	5.4	6.9	8.8	11.1	8.5	10.6	12.9	15.3
150	3.3	4.0	4.8	6.0	4.3	5.3	6.7	8.6	6.2	7.9	10.1	12.8	9.7	12.2	14.9	17.6
160	3.7	4.5	5.5	6.9	4.9	6.0	7.6	9.8	7.0	9.0	11.4	14.5	11.1	13.9	16.9	20.0
170	4.2	5.1	6.2	7.8	5.5	6.8	8.6	11.1	7.9	10.1	12.9	16.4	12.5	15.7	19.1	22.6
180	4.7	5.7	7.0	8.7	6.2	7.6	9.7	12.4	8.9	11.4	14.5	18.4	14.0	17.6	21.4	25.4
190	5.3	6.4	7.8	9.7	6.9	8.5	10.8	13.9	9.9	12.6	16.1	20.5	15.6	19.6	23.8	28.3
200	5.8	7.1	8.6	10.8	7.7	9.4	11.9	15.4	11.0	14.0	17.9	22.7	17.3	21.7	26.4	31.3
210	6.4	7.8	9.5	11.9	8.5	10.4	13.2	16.9	12.1	15.5	19.7	25.1	19.1	23.9	29.1	34.5
220	7.1	8.6	10.4	13.0	9.3	11.4	14.5	18.6	13.3	17.0	21.6	27.5	20.9	26.2	31.9	37.9
230	7.7	9.4	11.4	14.2	10.2	12.5	15.8	20.3	14.5	18.5	23.6	30.1	22.9	28.7	34.9	41.4
240	8.4	10.2	12.4	15.5	11.1	13.6	17.2	22.1	15.8	20.2	25.7	32.7	24.9	31.2	38.0	45.1
250	9.1	11.1	13.4	16.8	12.0	14.7	18.7	24.0	17.1	21.9	27.9	35.5	27.0	33.9	41.3	48.9
260	9.9	12.0	14.5	18.2	13.0	15.9	20.2	26.0	18.5	23.7	30.2	38.4	29.2	36.6	44.6	52.9
270	10.6	12.9	15.7	19.6	14.0	17.2	21.8	28.0	20.0	25.5	32.6	41.4	31.5	39.5	48.1	57.1
280	11.4	13.9	16.9	21.1	15.1	18.5	23.4	30.1	21.5	27.5	35.0	44.5	33.9	42.5	51.7	61.4
290	12.3	14.9	18.1	22.6	16.1	19.8	25.1	32.3	23.1	29.5	37.6	47.8	36.3	45.6	55.5	65.9
300	13.1	16.0	19.4	24.2	17.3	21.2	26.9	34.6	24.7	31.5	40.2	51.1	38.9	48.8	59.4	70.5

Supersedes 7/07 Issue – Revised Sag Tables

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**167**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**75**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	1.4	1.6	1.9	2.3	2.8	4.0	4.3	5.2
75	3.5	4.0	4.6	5.5	6.6	9.1	9.7	10.9
100	6.7	7.8	9.1	10.8	12.8	16.6	17.3	18.7
125	12.1	13.9	16.2	18.7	21.5	26.0	26.9	28.7
150	20.2	23.0	26.2	29.3	32.6	37.8	38.8	40.6
175	31.7	35.3	38.9	42.6	46.2	51.6	52.7	54.7
200	46.4	50.4	54.4	58.3	62.0	67.7	68.8	70.9
225	64.1	68.3	72.4	76.3	80.2	86.0	87.1	89.3
250	84.2	88.4	92.6	96.6	100.6	106.6	107.6	109.8
275	106.7	111.0	115.2	119.3	123.2	129.2	130.3	132.6
300	131.6	135.8	140.0	144.1	148.1	154.2	155.4	157.6

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½" ICE	**½" ICE**	**6 LB. WIND**	**4 LB. WIND, ½" ICE**
DEAD END SPAN (FEET)				
50	4.3	3.8	2.3	*6,800
75	9.6	8.8	5.6	*6,800
100	17.0	15.8	10.9	*6,800
125	26.8	25.1	18.6	*6,800
150	38.5	36.6	29.0	*6,800
175	52.4	50.3	42.0	*6,800
200	68.5	66.1	57.5	*6,800
225	86.9	84.4	75.4	*6,800
250	107.4	104.6	95.6	*6,800
275	130.1	127.3	118.2	*6,800
300	155.0	152.3	143.0	*6,800
** Note: Design Specification Constraint*				

Supersedes 7/07 Issue – Revised Sag Tables

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	*13800 lbs.	TRANSVERSE	2.5390 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	*0.1450 sq. in.	VERTICAL	5.865 Lb/Ft			
R. (@ 25˚C)	0.0373 Ω / 1000’	TOTAL	6.691 Lb/Ft	528	NORMAL	739
R. (@ 75˚C)	0.0447 Ω / 1000’			647	EMERGENCY	819
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	23.41˚			
MESSENGER DIAMETER	0.487”					
CONDUCTOR DIAMETER	1.042”					
SYSTEM WEIGHT	2307 lbs / 1000’					

Note: Quantities identified with an “ * “ are for the messenger only. All other quantities are specified for the complete spacer cable system.

Supersedes 7/07 Issue – Revised Sag Tables

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	4,127	3,414	2,956	2,421	3,846	3,149	2,706	2,195	3,017	2,386	1,998	1,574	2,056	1,561	1,279	1,007
ACTUAL SPAN (FEET)																
50	0.3	0.3	0.4	0.5	0.3	0.4	0.4	0.5	0.4	0.5	0.6	0.7	0.6	0.7	0.9	1.2
60	0.4	0.5	0.6	0.7	0.4	0.5	0.6	0.8	0.6	0.7	0.8	1.1	0.8	1.0	1.3	1.7
70	0.6	0.6	0.8	0.9	0.6	0.7	0.9	1.0	0.8	0.9	1.2	1.5	1.1	1.4	1.8	2.3
80	0.7	0.8	1.0	1.2	0.8	0.9	1.1	1.4	1.0	1.2	1.5	1.9	1.5	1.9	2.3	3.0
90	0.9	1.1	1.3	1.6	1.0	1.2	1.4	1.7	1.3	1.5	1.9	2.4	1.8	2.3	3.0	3.8
100	1.2	1.3	1.6	1.9	1.2	1.4	1.8	2.1	1.6	1.9	2.4	3.0	2.3	2.9	3.7	4.7
110	1.4	1.6	2.0	2.3	1.5	1.7	2.1	2.6	1.9	2.3	2.8	3.6	2.8	3.5	4.4	5.7
120	1.7	1.9	2.3	2.8	1.8	2.1	2.5	3.1	2.3	2.7	3.4	4.3	3.3	4.2	5.3	6.7
130	1.9	2.2	2.7	3.2	2.1	2.4	3.0	3.6	2.6	3.2	4.0	5.0	3.9	4.9	6.2	7.9
140	2.3	2.6	3.2	3.8	2.4	2.8	3.4	4.2	3.1	3.7	4.6	5.8	4.5	5.7	7.2	9.2
150	2.6	2.9	3.6	4.3	2.8	3.3	4.0	4.8	3.5	4.2	5.3	6.7	5.1	6.5	8.2	10.5
160	2.9	3.4	4.1	4.9	3.1	3.7	4.5	5.5	4.0	4.8	6.0	7.6	5.8	7.4	9.4	12.0
170	3.3	3.8	4.7	5.5	3.5	4.2	5.1	6.2	4.5	5.5	6.8	8.6	6.6	8.4	10.6	13.5
180	3.7	4.2	5.2	6.2	4.0	4.7	5.7	6.9	5.1	6.1	7.6	9.6	7.4	9.4	11.9	15.2
190	4.2	4.7	5.8	6.9	4.4	5.2	6.4	7.7	5.7	6.8	8.5	10.8	8.2	10.4	13.2	16.9
200	4.6	5.2	6.5	7.7	4.9	5.8	7.0	8.5	6.3	7.6	9.4	11.9	9.1	11.6	14.6	18.7
210	5.1	5.8	7.1	8.5	5.4	6.4	7.8	9.4	6.9	8.3	10.4	13.1	10.1	12.8	16.1	20.6
220	5.6	6.3	7.8	9.3	5.9	7.0	8.5	10.3	7.6	9.1	11.4	14.4	11.0	14.0	17.7	22.7
230	6.1	6.9	8.5	10.2	6.5	7.6	9.3	11.3	8.3	10.0	12.4	15.8	12.1	15.3	19.4	24.8
240	6.6	7.5	9.3	11.1	7.1	8.3	10.1	12.3	9.0	10.9	13.5	17.2	13.1	16.7	21.1	27.0
250	7.2	8.2	10.1	12.0	7.7	9.0	11.0	13.3	9.8	11.8	14.7	18.6	14.3	18.1	22.9	29.3
260	7.8	8.9	10.9	13.0	8.3	9.8	11.9	14.4	10.6	12.8	15.9	20.1	15.4	19.6	24.7	31.6
270	8.4	9.6	11.8	14.0	8.9	10.5	12.8	15.6	11.4	13.8	17.1	21.7	16.6	21.1	26.7	34.1
280	9.0	10.3	12.6	15.1	9.6	11.3	13.8	16.7	12.3	14.8	18.4	23.3	17.9	22.7	28.7	36.7
290	9.7	11.0	13.6	16.1	10.3	12.2	14.8	17.9	13.2	15.9	19.8	25.0	19.2	24.3	30.8	39.4
300	10.4	11.8	14.5	17.3	11.0	13.0	15.8	19.2	14.1	17.0	21.2	26.8	20.5	26.0	32.9	42.1

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	167	176	194
TEMP. ˚C	-18	0	15	32	50	75	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.8	2.2	2.5	3.0	3.7	5.5	5.9	6.8
75	4.2	4.8	5.6	6.7	8.0	10.8	11.3	12.5
100	7.6	8.6	10.1	11.6	13.7	17.2	17.9	19.3
125	12.1	13.8	15.7	17.9	20.4	24.6	25.4	27.1
150	17.9	20.0	22.6	25.3	28.3	33.2	34.1	36.0
175	27.2	30.4	33.6	37.0	40.4	45.8	46.8	48.8
200	40.6	44.3	48.0	51.8	55.6	61.3	62.4	64.6
225	57.0	61.1	65.2	69.1	73.1	79.1	80.2	82.4
250	76.3	80.5	84.7	88.9	92.9	99.1	100.2	102.5
275	98.2	102.5	106.8	111.0	115.1	121.2	122.4	124.7
300	122.4	126.7	131.0	135.2	139.4	145.7	146.9	149.2

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	5.5	5.0	3.1	5,204
75	11.5	10.6	7.0	5,591
100	19.1	17.5	12.0	5,989
125	28.0	25.8	18.5	6,372
150	38.2	35.4	26.0	6,731
175	51.5	48.2	37.6	*6,800
200	67.2	63.6	52.2	*6,800
225	85.2	81.4	69.4	*6,800
250	105.4	101.3	88.9	*6,800
275	127.7	123.4	110.9	*6,800
300	152.2	147.7	135.1	*6,800
Note: Design Specification Constraint				

Supersedes 7/07 Issue – Revised Sag Tables

PHYSICAL PROPERTIES	
R.B.S.	*19500 lbs.
C.S.A.	*0.1785 sq. in.
R. (@ 25˚C)	0.0527 Ω / 1000’
R. (@ 75˚C)	0.0629 Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
MESSENGER DIAMETER	0.541”
CONDUCTOR DIAMETER	0.937”
SYSTEM WEIGHT	2002 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	2.4501 Lb/Ft
VERTICAL	5.398 Lb/Ft
TOTAL	6.228 Lb/Ft
SWING	24.41˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
425	**NORMAL**	593
519	**EMERGENCY**	657

Note: Quantities identified with an “ * “ are for the messenger only. All other quantities are specified for the complete spacer cable system.

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	4,689	3,833	3,289	2,661	3,820	3,032	2,545	2,007	2,888	2,217	1,824	1,426	2,004	1,520	1,261	1,026
ACTUAL SPAN (FEET)																
50	0.3	0.4	0.5	0.6	0.4	0.5	0.6	0.8	0.6	0.7	0.9	1.1	0.8	1.0	1.3	1.6
60	0.5	0.6	0.7	0.9	0.6	0.7	0.9	1.2	0.8	1.0	1.3	1.6	1.2	1.5	1.8	2.3
70	0.7	0.8	0.9	1.2	0.8	1.0	1.2	1.6	1.1	1.4	1.7	2.2	1.6	2.0	2.5	3.1
80	0.9	1.0	1.2	1.5	1.1	1.3	1.6	2.0	1.4	1.8	2.3	2.9	2.1	2.6	3.3	4.0
90	1.1	1.3	1.6	1.9	1.4	1.6	2.0	2.6	1.8	2.3	2.9	3.6	2.6	3.3	4.1	5.1
100	1.4	1.6	1.9	2.4	1.7	2.0	2.5	3.2	2.2	2.8	3.5	4.5	3.2	4.1	5.1	6.3
110	1.7	2.0	2.3	2.9	2.1	2.5	3.0	3.9	2.7	3.4	4.3	5.5	3.9	4.9	6.2	7.6
120	2.0	2.3	2.8	3.4	2.5	2.9	3.6	4.6	3.2	4.0	5.1	6.5	4.6	5.9	7.3	9.0
130	2.3	2.7	3.2	4.0	2.9	3.4	4.2	5.4	3.8	4.7	6.0	7.6	5.4	6.9	8.6	10.6
140	2.7	3.2	3.8	4.7	3.3	4.0	4.9	6.3	4.4	5.5	6.9	8.8	6.3	8.0	10.0	12.3
150	3.1	3.6	4.3	5.4	3.8	4.6	5.6	7.2	5.0	6.3	7.9	10.1	7.2	9.2	11.5	14.1
160	3.5	4.1	4.9	6.1	4.4	5.2	6.4	8.2	5.7	7.2	9.0	11.5	8.2	10.4	13.1	16.1
170	4.0	4.7	5.5	6.9	4.9	5.9	7.2	9.2	6.5	8.1	10.2	13.0	9.3	11.8	14.7	18.1
180	4.5	5.2	6.2	7.7	5.5	6.6	8.1	10.4	7.2	9.1	11.4	14.6	10.4	13.2	16.5	20.3
190	5.0	5.8	6.9	8.6	6.2	7.3	9.0	11.6	8.1	10.1	12.7	16.3	11.6	14.7	18.4	22.6
200	5.5	6.5	7.7	9.5	6.8	8.1	10.0	12.8	8.9	11.2	14.1	18.0	12.8	16.3	20.4	25.1
210	6.1	7.1	8.5	10.5	7.5	9.0	11.1	14.1	9.8	12.3	15.6	19.9	14.2	17.9	22.5	27.7
220	6.7	7.8	9.3	11.5	8.3	9.8	12.1	15.5	10.8	13.5	17.1	21.8	15.5	19.7	24.7	30.3
230	7.3	8.6	10.2	12.6	9.0	10.8	13.3	16.9	11.8	14.8	18.7	23.8	17.0	21.5	27.0	33.2
240	8.0	9.3	11.1	13.7	9.8	11.7	14.4	18.4	12.9	16.1	20.3	26.0	18.5	23.4	29.4	36.1
250	8.6	10.1	12.0	14.9	10.7	12.7	15.7	20.0	14.0	17.5	22.0	28.2	20.1	25.4	31.9	39.2
260	9.3	10.9	13.0	16.1	11.5	13.8	16.9	21.6	15.1	18.9	23.8	30.5	21.7	27.5	34.5	42.4
270	10.1	11.8	14.0	17.4	12.4	14.8	18.3	23.3	16.3	20.4	25.7	32.8	23.4	29.7	37.2	45.7
280	10.8	12.7	15.1	18.7	13.4	16.0	19.7	25.1	17.5	21.9	27.6	35.3	25.2	31.9	40.0	49.2
290	11.6	13.6	16.1	20.0	14.4	17.1	21.1	26.9	18.8	23.5	29.7	37.9	27.0	34.2	42.9	52.7
300	12.4	14.6	17.3	21.4	15.4	18.3	22.6	28.8	20.1	25.2	31.7	40.6	28.9	36.6	45.9	56.4

Supersedes 7/07 Issue – Revised Sag Tables

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	167	176	194
TEMP. ˚C	-18	0	15	32	50	75	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.2	1.3	1.6	1.8	2.3	3.4	3.7	4.4
75	2.8	3.2	3.7	4.4	5.5	7.9	8.4	9.7
100	5.4	6.2	7.3	8.9	10.7	14.4	15.2	16.8
125	9.6	11.2	13.1	15.5	18.2	23.0	24.0	25.8
150	16.0	18.5	21.5	24.7	28.2	33.7	34.8	36.8
175	25.4	28.9	32.8	36.6	40.6	46.4	47.5	49.7
200	38.2	42.4	46.7	50.9	55.0	61.2	62.4	64.7
225	53.9	58.6	63.0	67.3	71.6	78.0	79.2	81.5
250	72.2	76.9	81.6	86.0	90.4	96.8	98.0	100.4
275	92.9	97.7	102.2	106.8	111.1	117.7	118.9	121.3
300	115.8	120.5	125.2	129.6	133.9	140.6	141.8	144.4

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	4.0	3.5	2.0	6,791
75	8.9	7.9	4.8	*6,800
100	15.7	14.3	9.2	*6,800
125	24.6	22.7	15.8	*6,800
150	35.4	33.1	24.8	*6,800
175	48.2	45.6	36.5	*6,800
200	63.1	60.1	50.5	*6,800
225	79.9	76.8	66.7	*6,800
250	98.9	95.4	85.3	*6,800
275	119.8	116.2	106.0	*6,800
300	142.7	139.1	128.6	*6,800
** Note: Design Specification Constraint*				

Supersedes 7/07 Issue – Revised Sag Tables

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	*13800 lbs.	TRANSVERSE	2.4343 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	*0.1450 sq. in.	VERTICAL	5.249 Lb/Ft			
R. (@ 25˚C)	0.0527 Ω / 1000’	TOTAL	6.086 Lb/Ft	425	NORMAL	593
R. (@ 75˚C)	0.0629 Ω / 1000’			519	EMERGENCY	657
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	24.88˚			
MESSENGER DIAMETER	0.487”					
CONDUCTOR DIAMETER	0.937”					
SYSTEM WEIGHT	1887 lbs / 1000’					

Note: Quantities identified with an “ * “ are for the messenger only. All other quantities are specified for the complete spacer cable system.

Supersedes 7/07 Issue – Revised Sag Tables

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	4,354	3,630	3,164	2,614	4,169	3,456	2,998	2,462	3,560	2,885	2,459	1,976	2,670	2,083	1,730	1,359
ACTUAL SPAN (FEET)																
50	0.3	0.3	0.4	0.4	0.3	0.3	0.4	0.5	0.3	0.4	0.5	0.6	0.4	0.5	0.7	0.9
60	0.4	0.4	0.5	0.6	0.4	0.5	0.6	0.7	0.5	0.6	0.7	0.9	0.6	0.8	1.0	1.2
70	0.5	0.6	0.7	0.9	0.5	0.7	0.8	0.9	0.7	0.8	0.9	1.2	0.9	1.1	1.3	1.7
80	0.7	0.8	0.9	1.1	0.7	0.9	1.0	1.2	0.9	1.0	1.2	1.5	1.1	1.4	1.7	2.2
90	0.9	1.0	1.2	1.4	0.9	1.1	1.3	1.6	1.1	1.3	1.6	1.9	1.4	1.8	2.2	2.8
100	1.1	1.2	1.5	1.8	1.1	1.3	1.5	1.9	1.3	1.6	1.9	2.4	1.8	2.2	2.7	3.5
110	1.3	1.5	1.8	2.1	1.4	1.6	1.9	2.3	1.6	1.9	2.3	2.9	2.1	2.6	3.3	4.2
120	1.5	1.8	2.1	2.5	1.6	1.9	2.2	2.8	1.9	2.3	2.8	3.4	2.5	3.1	3.9	5.0
130	1.8	2.1	2.5	3.0	1.9	2.3	2.6	3.2	2.3	2.7	3.2	4.0	3.0	3.7	4.6	5.8
140	2.1	2.4	2.9	3.5	2.2	2.6	3.0	3.8	2.6	3.1	3.8	4.7	3.5	4.3	5.3	6.8
150	2.4	2.8	3.3	4.0	2.5	3.0	3.5	4.3	3.0	3.5	4.3	5.4	4.0	4.9	6.1	7.8
160	2.8	3.2	3.7	4.5	2.9	3.4	4.0	4.9	3.4	4.0	4.9	6.1	4.5	5.6	6.9	8.8
170	3.1	3.6	4.2	5.1	3.2	3.9	4.5	5.5	3.9	4.5	5.5	6.9	5.1	6.3	7.8	10.0
180	3.5	4.0	4.7	5.7	3.6	4.3	5.0	6.2	4.3	5.1	6.2	7.7	5.7	7.0	8.7	11.2
190	3.9	4.4	5.3	6.4	4.0	4.8	5.6	6.9	4.8	5.7	6.9	8.6	6.4	7.8	9.7	12.5
200	4.3	4.9	5.8	7.1	4.5	5.3	6.2	7.7	5.3	6.3	7.7	9.6	7.1	8.7	10.8	13.8
210	4.7	5.4	6.4	7.8	4.9	5.9	6.8	8.5	5.9	6.9	8.5	10.5	7.8	9.6	11.9	15.2
220	5.2	6.0	7.1	8.5	5.4	6.5	7.5	9.3	6.4	7.6	9.3	11.6	8.6	10.5	13.1	16.7
230	5.7	6.5	7.7	9.3	5.9	7.1	8.2	10.2	7.0	8.3	10.2	12.6	9.4	11.5	14.3	18.3
240	6.2	7.1	8.4	10.2	6.5	7.7	8.9	11.1	7.7	9.1	11.1	13.8	10.2	12.5	15.6	19.9
250	6.7	7.7	9.1	11.0	7.0	8.4	9.7	12.0	8.3	9.8	12.0	14.9	11.1	13.6	16.9	21.6
260	7.3	8.3	9.9	11.9	7.6	9.0	10.5	13.0	9.0	10.6	13.0	16.2	12.0	14.7	18.3	23.3
270	7.8	9.0	10.6	12.9	8.2	9.7	11.3	14.0	9.7	11.5	14.0	17.4	12.9	15.8	19.7	25.2
280	8.4	9.7	11.4	13.8	8.8	10.5	12.1	15.1	10.4	12.3	15.1	18.7	13.9	17.0	21.2	27.0
290	9.0	10.4	12.3	14.9	9.4	11.2	13.0	16.1	11.2	13.2	16.1	20.1	14.9	18.2	22.7	29.0
300	9.7	11.1	13.1	15.9	10.1	12.0	13.9	17.3	12.0	14.2	17.3	21.5	15.9	19.5	24.3	31.1

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**167**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**75**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	1.4	1.7	2.0	2.5	3.1	4.8	5.3	6.1
75	3.4	4.0	4.6	5.5	6.8	9.5	10.1	11.3
100	6.1	7.1	8.2	9.7	11.5	15.1	15.8	17.4
125	9.7	11.2	12.8	14.9	17.4	21.7	22.6	24.4
150	14.3	16.2	18.5	21.1	24.1	29.2	30.2	32.3
175	21.4	24.1	27.2	30.6	34.2	40.0	41.0	43.3
200	32.2	35.9	39.7	43.8	47.8	54.1	55.3	57.6
225	46.3	50.6	55.1	59.4	63.7	70.3	71.5	73.9
250	63.5	68.2	72.8	77.4	81.8	88.6	89.9	92.3
275	83.3	88.2	92.9	97.6	102.0	108.8	110.2	112.7
300	105.5	110.4	115.2	119.8	124.3	131.3	132.6	135.1

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			**TENSION (LBS.)**
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½" ICE	**½" ICE**	**6 LB. WIND**	**4 LB. WIND, ½" ICE**
DEAD END SPAN (FEET)				
50	5.0	4.6	2.6	5,164
75	10.7	9.6	5.9	5,531
100	17.8	16.0	10.3	5,919
125	26.0	23.5	15.8	6,301
150	35.4	32.2	22.3	6,667
175	47.3	43.4	31.9	*6,800
200	61.8	57.5	44.9	*6,800
225	78.4	73.7	60.2	*6,800
250	96.8	91.8	78.0	*6,800
275	117.4	112.0	98.0	*6,800
300	139.8	134.3	120.1	*6,800
** Note: Design Specification Constraint*				

Supersedes 7/07 Issue – Revised Sag Tables

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	*19500 lbs.	TRANSVERSE	2.5407 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	*0.1785 sq. in.	VERTICAL	5.367 Lb/Ft			
R. (@ 25˚C)	0.166 Ω / 1000’	TOTAL	6.238 Lb/Ft	200	NORMAL	280
R. (@ 75˚C)	0.195 Ω / 1000’			244	EMERGENCY	310
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	25.33˚			
MESSENGER DIAMETER	0.541”					
CONDUCTOR DIAMETER	1.028”					
SYSTEM WEIGHT	1793 lbs / 1000’					

Note: Quantities identified with an “ * “ are for the messenger only. All other quantities are specified for the complete spacer cable system.

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	4,684	3,828	3,284	2,656	3,813	3,025	2,538	2,001	2,878	2,209	1,817	1,420	1,994	1,513	1,256	1,022
ACTUAL SPAN (FEET)																
50	0.3	0.4	0.5	0.6	0.4	0.5	0.6	0.8	0.6	0.7	0.9	1.1	0.8	1.0	1.3	1.6
60	0.5	0.6	0.7	0.9	0.6	0.7	0.9	1.2	0.8	1.0	1.3	1.6	1.2	1.5	1.8	2.3
70	0.7	0.8	0.9	1.2	0.8	1.0	1.2	1.6	1.1	1.4	1.7	2.2	1.6	2.0	2.5	3.1
80	0.9	1.0	1.2	1.5	1.1	1.3	1.6	2.0	1.4	1.8	2.3	2.9	2.1	2.6	3.3	4.0
90	1.1	1.3	1.6	1.9	1.4	1.6	2.0	2.6	1.8	2.3	2.9	3.6	2.6	3.3	4.1	5.1
100	1.4	1.6	1.9	2.4	1.7	2.0	2.5	3.2	2.2	2.8	3.5	4.5	3.2	4.1	5.1	6.3
110	1.7	2.0	2.3	2.9	2.1	2.5	3.0	3.9	2.7	3.4	4.3	5.5	3.9	5.0	6.2	7.6
120	2.0	2.3	2.8	3.4	2.5	2.9	3.6	4.6	3.2	4.0	5.1	6.5	4.6	5.9	7.3	9.1
130	2.3	2.7	3.2	4.0	2.9	3.4	4.2	5.4	3.8	4.7	6.0	7.6	5.4	6.9	8.6	10.6
140	2.7	3.2	3.8	4.7	3.3	4.0	4.9	6.3	4.4	5.5	6.9	8.8	6.3	8.0	10.0	12.3
150	3.1	3.6	4.3	5.4	3.8	4.6	5.6	7.2	5.0	6.3	7.9	10.1	7.2	9.2	11.5	14.2
160	3.5	4.1	4.9	6.1	4.4	5.2	6.4	8.2	5.7	7.2	9.0	11.5	8.2	10.5	13.1	16.1
170	4.0	4.7	5.5	6.9	4.9	5.9	7.2	9.2	6.5	8.1	10.2	13.0	9.3	11.8	14.7	18.2
180	4.5	5.2	6.2	7.7	5.5	6.6	8.1	10.4	7.2	9.1	11.4	14.6	10.4	13.3	16.5	20.4
190	5.0	5.8	6.9	8.6	6.2	7.3	9.0	11.6	8.1	10.1	12.7	16.3	11.6	14.8	18.4	22.7
200	5.5	6.5	7.7	9.5	6.8	8.1	10.0	12.8	8.9	11.2	14.1	18.0	12.8	16.4	20.4	25.2
210	6.1	7.1	8.5	10.5	7.5	9.0	11.1	14.1	9.8	12.3	15.6	19.9	14.2	18.1	22.5	27.8
220	6.7	7.8	9.3	11.5	8.3	9.8	12.1	15.5	10.8	13.5	17.1	21.8	15.5	19.8	24.7	30.5
230	7.3	8.6	10.2	12.6	9.0	10.8	13.3	16.9	11.8	14.8	18.7	23.8	17.0	21.7	27.0	33.3
240	8.0	9.3	11.1	13.7	9.8	11.7	14.4	18.4	12.9	16.1	20.3	26.0	18.5	23.6	29.4	36.3
250	8.6	10.1	12.0	14.9	10.7	12.7	15.7	20.0	14.0	17.5	22.0	28.2	20.1	25.6	31.9	39.4
260	9.3	10.9	13.0	16.1	11.5	13.8	16.9	21.6	15.1	18.9	23.8	30.5	21.7	27.7	34.5	42.6
270	10.1	11.8	14.0	17.4	12.4	14.8	18.3	23.3	16.3	20.4	25.7	32.8	23.4	29.9	37.2	45.9
280	10.8	12.7	15.1	18.7	13.4	16.0	19.7	25.1	17.5	21.9	27.6	35.3	25.2	32.1	40.0	49.4
290	11.6	13.6	16.1	20.0	14.4	17.1	21.1	26.9	18.8	23.5	29.7	37.9	27.0	34.5	42.9	53.0
300	12.4	14.6	17.3	21.4	15.4	18.3	22.6	28.8	20.1	25.2	31.7	40.6	28.9	36.9	45.9	56.7

Supersedes 7/07 Issue – Revised Sag Tables

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**167**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**75**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	1.1	1.2	1.3	1.7	2.0	3.1	3.4	4.1
75	2.5	2.9	3.4	4.1	5.0	7.3	7.9	9.2
100	4.9	5.6	6.7	8.0	10.0	13.7	14.5	16.2
125	8.6	10.2	12.1	14.4	17.3	22.2	23.2	25.1
150	14.8	17.2	20.2	23.5	27.1	32.9	34.0	36.0
175	23.9	27.5	31.3	35.4	39.4	45.5	46.7	49.0
200	36.5	40.9	45.2	49.7	53.9	60.2	61.4	63.8
225	52.3	57.0	61.7	66.2	70.6	77.0	78.2	80.6
250	70.8	75.6	80.3	84.8	89.3	95.9	97.2	99.6
275	91.6	96.4	101.2	105.7	110.2	116.8	118.1	120.5
300	114.5	119.3	124.0	128.5	133.1	139.8	141.0	143.5

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½" ICE	**½" ICE**	**6 LB. WIND**	**4 LB. WIND, ½" ICE**
DEAD END SPAN (FEET)				
50	4.0	3.5	1.9	*6,800
75	8.9	7.8	4.7	*6,800
100	15.7	14.2	9.0	*6,800
125	24.6	22.6	15.6	*6,800
150	35.5	33.0	24.6	*6,800
175	48.4	45.5	36.1	*6,800
200	63.2	60.1	50.2	*6,800
225	80.0	76.7	66.5	*6,800
250	99.0	95.4	85.1	*6,800
275	119.9	116.2	105.7	*6,800
300	142.9	139.1	128.5	*6,800

** Note: Design Specification Constraint*

Supersedes 7/07 Issue – Revised Sag Tables

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	*13800 lbs.	**TRANSVERSE**	2.5231 Lb/Ft	**SUMMER (37.7˚C)**	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
C.S.A.	*0.1450 sq. in.	**VERTICAL**	5.218 Lb/Ft			
R. (@ 25˚C)	0.166 Ω / 1000’	**TOTAL**	6.096 Lb/Ft	200	**NORMAL**	280
R. (@ 75˚C)	0.195 Ω / 1000’			244	**EMERGENCY**	310
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	**SWING**	25.81˚			
MESSENGER DIAMETER	0.487”					
CONDUCTOR DIAMETER	1.028”					
SYSTEM WEIGHT	1678 lbs / 1000’					

Note: Quantities identified with an “ * “ are for the messenger only. All other quantities are specified for the complete spacer cable system.

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				**150**				**175**				**200**			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	4,454	3,727	3,257	2,701	4,312	3,592	3,129	2,584	3,550	2,876	2,451	1,969	2,659	2,073	1,722	1,352
ACTUAL SPAN (FEET)																
50	0.3	0.3	0.4	0.4	0.3	0.3	0.4	0.5	0.3	0.4	0.5	0.6	0.4	0.5	0.7	0.9
60	0.4	0.4	0.5	0.6	0.4	0.5	0.5	0.7	0.5	0.6	0.7	0.9	0.6	0.8	1.0	1.3
70	0.5	0.6	0.7	0.9	0.5	0.6	0.7	0.9	0.7	0.8	0.9	1.2	0.9	1.1	1.3	1.7
80	0.7	0.8	0.9	1.1	0.7	0.8	1.0	1.2	0.9	1.0	1.2	1.5	1.1	1.4	1.7	2.2
90	0.9	1.0	1.2	1.4	0.9	1.0	1.2	1.5	1.1	1.3	1.6	1.9	1.4	1.8	2.2	2.8
100	1.1	1.2	1.5	1.8	1.1	1.3	1.5	1.8	1.3	1.6	1.9	2.4	1.8	2.2	2.7	3.5
110	1.3	1.5	1.8	2.1	1.3	1.6	1.8	2.2	1.6	1.9	2.3	2.9	2.1	2.6	3.3	4.2
120	1.5	1.8	2.1	2.5	1.5	1.8	2.2	2.6	1.9	2.3	2.8	3.4	2.5	3.1	3.9	5.0
130	1.8	2.1	2.5	3.0	1.8	2.2	2.5	3.1	2.3	2.7	3.2	4.0	3.0	3.7	4.6	5.9
140	2.1	2.4	2.9	3.5	2.1	2.5	2.9	3.6	2.6	3.1	3.8	4.7	3.5	4.3	5.4	6.8
150	2.4	2.8	3.3	4.0	2.4	2.9	3.4	4.1	3.0	3.5	4.3	5.4	4.0	4.9	6.1	7.8
160	2.8	3.2	3.7	4.5	2.7	3.3	3.8	4.6	3.4	4.0	4.9	6.1	4.5	5.6	7.0	8.9
170	3.1	3.6	4.2	5.1	3.1	3.7	4.3	5.2	3.9	4.5	5.5	6.9	5.1	6.3	7.9	10.1
180	3.5	4.0	4.7	5.7	3.5	4.2	4.8	5.9	4.3	5.1	6.2	7.7	5.7	7.0	8.8	11.3
190	3.9	4.4	5.3	6.4	3.9	4.6	5.4	6.5	4.8	5.7	6.9	8.6	6.4	7.8	9.9	12.6
200	4.3	4.9	5.8	7.1	4.3	5.1	6.0	7.3	5.3	6.3	7.7	9.6	7.1	8.7	10.9	13.9
210	4.7	5.4	6.4	7.8	4.7	5.7	6.6	8.0	5.9	6.9	8.5	10.5	7.8	9.6	12.0	15.3
220	5.2	6.0	7.1	8.5	5.2	6.2	7.2	8.8	6.4	7.6	9.3	11.6	8.6	10.5	13.2	16.8
230	5.7	6.5	7.7	9.3	5.6	6.8	7.9	9.6	7.0	8.3	10.2	12.6	9.4	11.5	14.4	18.4
240	6.2	7.1	8.4	10.2	6.1	7.4	8.6	10.4	7.7	9.1	11.1	13.8	10.2	12.5	15.7	20.0
250	6.7	7.7	9.1	11.0	6.7	8.0	9.3	11.3	8.3	9.8	12.0	14.9	11.1	13.6	17.1	21.8
260	7.3	8.3	9.9	11.9	7.2	8.7	10.1	12.3	9.0	10.6	13.0	16.2	12.0	14.7	18.5	23.5
270	7.8	9.0	10.6	12.9	7.8	9.4	10.9	13.2	9.7	11.5	14.0	17.4	12.9	15.8	19.9	25.4
280	8.4	9.7	11.4	13.8	8.4	10.1	11.7	14.2	10.4	12.3	15.1	18.7	13.9	17.0	21.4	27.3
290	9.0	10.4	12.3	14.9	9.0	10.8	12.6	15.3	11.2	13.2	16.1	20.1	14.9	18.2	23.0	29.3
300	9.7	11.1	13.1	15.9	9.6	11.6	13.4	16.3	12.0	14.2	17.3	21.5	15.9	19.5	24.6	31.3

Supersedes 7/07 Issue – Revised Sag Tables

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	167	176	194
TEMP. ˚C	-18	0	15	32	50	75	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1.3	1.6	1.8	2.3	2.9	4.4	4.8	5.8
75	3.0	3.5	4.1	4.9	6.1	8.8	9.4	10.7
100	5.4	6.2	7.3	8.6	10.4	14.0	14.8	16.4
125	8.5	9.8	11.4	13.3	15.7	20.2	21.1	22.9
150	12.5	14.3	16.4	19.0	22.0	27.1	28.2	30.2
175	19.6	22.3	25.4	28.9	32.6	38.6	39.7	42.1
200	30.0	33.8	37.8	42.0	46.2	52.7	54.0	56.4
225	44.0	48.6	53.2	57.7	62.2	69.0	70.2	72.7
250	61.3	66.2	71.0	75.7	80.3	87.2	88.6	91.1
275	81.4	86.4	91.2	96.0	100.6	107.6	109.0	111.5
300	103.7	108.7	113.5	118.3	123.0	130.1	131.4	133.9

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	5.0	4.4	2.6	5,179
75	10.7	9.5	5.8	5,561
100	17.6	15.7	10.0	5,966
125	25.8	23.2	15.2	6,368
150	35.0	31.6	21.5	6,756
175	47.4	43.3	31.6	*6,800
200	61.9	57.5	44.5	*6,800
225	78.5	73.6	59.9	*6,800
250	97.0	91.8	77.8	*6,800
275	117.5	112.0	97.7	*6,800
300	140.0	134.3	119.9	*6,800
** Note: Design Specification Constraint*				

Supersedes 7/07 Issue – Revised Sag Tables

PHYSICAL PROPERTIES	
R.B.S.	*19500 lbs.
C.S.A.	*0.1785 sq. in.
R. (@ 25˚C)	0.166 Ω / 1000’
R. (@ 75˚C)	0.195 Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
MESSENGER DIAMETER	0.541”
CONDUCTOR DIAMETER	0.728”
SYSTEM WEIGHT	1276 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	2.2411 Lb/Ft
VERTICAL	4.282 Lb/Ft
TOTAL	5.133 Lb/Ft
SWING	27.63˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
214	NORMAL	296
259	EMERGENCY	327

Note: Quantities identified with an “ * “ are for the messenger only. All other quantities are specified for the complete spacer cable system.

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	5,278	4,393	3,823	3,152	4,632	3,782	3,244	2,626	3,901	3,112	2,624	2,086	3,124	2,431	2,020	1,598
ACTUAL SPAN (FEET)																
50	0.3	0.3	0.4	0.5	0.3	0.4	0.5	0.6	0.4	0.5	0.6	0.8	0.5	0.6	0.8	1.0
60	0.4	0.5	0.6	0.7	0.5	0.6	0.7	0.9	0.6	0.7	0.9	1.1	0.7	0.9	1.1	1.4
70	0.6	0.7	0.8	1.0	0.7	0.8	1.0	1.2	0.8	1.0	1.2	1.5	1.0	1.2	1.6	2.0
80	0.8	0.9	1.1	1.3	0.9	1.1	1.3	1.6	1.1	1.3	1.6	2.0	1.3	1.6	2.0	2.6
90	1.0	1.1	1.4	1.7	1.1	1.3	1.6	2.0	1.3	1.6	2.0	2.5	1.7	2.1	2.6	3.3
100	1.2	1.4	1.7	2.1	1.4	1.7	2.0	2.5	1.6	2.0	2.4	3.1	2.0	2.5	3.2	4.0
110	1.5	1.7	2.0	2.5	1.7	2.0	2.4	3.0	2.0	2.4	2.9	3.7	2.5	3.1	3.8	4.9
120	1.8	2.0	2.4	3.0	2.0	2.4	2.8	3.5	2.4	2.9	3.5	4.5	2.9	3.6	4.6	5.8
130	2.1	2.3	2.9	3.5	2.3	2.8	3.3	4.1	2.8	3.4	4.1	5.2	3.4	4.3	5.4	6.8
140	2.4	2.7	3.3	4.1	2.7	3.3	3.9	4.8	3.2	3.9	4.8	6.1	4.0	5.0	6.2	7.9
150	2.8	3.1	3.8	4.7	3.1	3.7	4.4	5.5	3.7	4.5	5.5	7.0	4.6	5.7	7.2	9.0
160	3.1	3.6	4.3	5.3	3.5	4.2	5.1	6.3	4.2	5.1	6.2	7.9	5.2	6.5	8.1	10.3
170	3.6	4.0	4.9	6.0	4.0	4.8	5.7	7.1	4.8	5.8	7.0	8.9	5.9	7.3	9.2	11.6
180	4.0	4.5	5.5	6.7	4.5	5.4	6.4	7.9	5.3	6.5	7.9	10.0	6.6	8.2	10.3	13.0
190	4.4	5.0	6.1	7.5	5.0	6.0	7.1	8.9	5.9	7.2	8.8	11.2	7.4	9.1	11.5	14.5
200	4.9	5.6	6.8	8.3	5.5	6.6	7.9	9.8	6.6	8.0	9.7	12.4	8.2	10.1	12.7	16.1
210	5.4	6.1	7.5	9.1	6.1	7.3	8.7	10.8	7.3	8.8	10.7	13.7	9.0	11.2	14.0	17.7
220	5.9	6.7	8.2	10.0	6.7	8.0	9.6	11.9	8.0	9.7	11.8	15.0	9.9	12.3	15.4	19.5
230	6.5	7.3	8.9	11.0	7.3	8.8	10.4	13.0	8.7	10.6	12.9	16.4	10.8	13.4	16.8	21.3
240	7.1	8.0	9.7	11.9	8.0	9.6	11.4	14.1	9.5	11.6	14.0	17.8	11.8	14.6	18.3	23.2
250	7.7	8.7	10.6	13.0	8.7	10.4	12.3	15.3	10.3	12.5	15.2	19.3	12.8	15.8	19.9	25.1
260	8.3	9.4	11.4	14.0	9.4	11.2	13.3	16.6	11.1	13.6	16.4	20.9	13.8	17.1	21.5	27.2
270	9.0	10.1	12.3	15.1	10.1	12.1	14.4	17.9	12.0	14.6	17.7	22.6	14.9	18.5	23.2	29.3
280	9.6	10.9	13.2	16.3	10.9	13.0	15.5	19.2	12.9	15.7	19.0	24.3	16.0	19.8	24.9	31.5
290	10.3	11.7	14.2	17.4	11.7	13.9	16.6	20.6	13.8	16.9	20.4	26.0	17.2	21.3	26.7	33.8
300	11.1	12.5	15.2	18.7	12.5	14.9	17.8	22.1	14.8	18.0	21.9	27.9	18.4	22.8	28.6	36.2

Supersedes 7/07 Issue – Revised Sag Tables

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	167	176	194
TEMP. ˚C	-18	0	15	32	50	75	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	0.7	0.8	1.0	1.2	1.4	2.3	2.5	3.2
75	1.7	1.9	2.3	2.8	3.5	5.3	5.9	7.1
100	3.2	3.8	4.4	5.4	6.8	10.2	11.0	12.7
125	5.6	6.6	7.8	9.6	12.0	16.9	18.0	20.2
150	9.1	10.8	13.0	15.8	19.3	25.6	26.8	29.3
175	14.5	17.2	20.6	24.6	29.0	36.1	37.4	40.1
200	22.4	26.5	31.1	35.9	40.9	48.4	49.8	52.6
225	33.7	38.8	44.2	49.4	54.7	62.5	64.0	66.7
250	48.1	53.8	59.5	65.0	70.3	78.2	79.8	82.7
275	65.0	71.0	76.8	82.4	87.8	95.9	97.3	100.2
300	84.2	90.2	96.0	101.6	107.0	115.1	116.6	119.5

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	3.4	2.8	1.4	6,726
75	7.4	6.2	3.4	*6,800
100	13.3	11.4	6.4	*6,800
125	20.8	18.1	10.9	*6,800
150	30.0	26.5	17.3	*6,800
175	40.8	36.8	25.9	*6,800
200	53.4	48.8	36.8	*6,800
225	67.6	62.6	50.0	*6,800
250	83.5	78.2	65.3	*6,800
275	101.2	95.5	82.4	*6,800
300	120.5	114.7	101.5	*6,800
* Note: Design Specification Constraint				

Supersedes 7/07 Issue – Revised Sag Tables

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	*13800 lbs.	TRANSVERSE	2.2253 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	*0.1450 sq. in.	VERTICAL	4.133 Lb/Ft			
R. (@ 25˚C)	0.166 Ω / 1000’	TOTAL	4.994 Lb/Ft	214	NORMAL	296
R. (@ 75˚C)	0.195 Ω / 1000’			259	EMERGENCY	327
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	28.30˚			
MESSENGER DIAMETER	0.487”					
CONDUCTOR DIAMETER	0.728”					
SYSTEM WEIGHT	1161 lbs / 1000’					

Note: Quantities identified with an “ * “ are for the messenger only. All other quantities are specified for the complete spacer cable system.

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	4,637	3,904	3,428	2,861	4,576	3,846	3,373	2,812	4,473	3,748	3,280	2,728	3,785	3,097	2,662	2,164
ACTUAL SPAN (FEET)																
50	0.2	0.3	0.3	0.4	0.3	0.3	0.3	0.4	0.3	0.3	0.4	0.4	0.3	0.4	0.4	0.5
60	0.4	0.4	0.5	0.6	0.4	0.4	0.5	0.6	0.4	0.4	0.5	0.6	0.4	0.5	0.6	0.8
70	0.5	0.6	0.7	0.8	0.5	0.6	0.7	0.8	0.5	0.6	0.7	0.8	0.6	0.7	0.9	1.1
80	0.6	0.7	0.9	1.0	0.6	0.8	0.9	1.1	0.7	0.8	0.9	1.1	0.8	0.9	1.1	1.4
90	0.8	0.9	1.1	1.3	0.8	1.0	1.1	1.3	0.9	1.0	1.2	1.4	1.0	1.2	1.4	1.7
100	1.0	1.2	1.4	1.6	1.0	1.2	1.4	1.7	1.1	1.2	1.4	1.7	1.2	1.5	1.8	2.2
110	1.2	1.4	1.7	2.0	1.2	1.4	1.7	2.0	1.3	1.5	1.8	2.1	1.5	1.8	2.1	2.6
120	1.4	1.7	2.0	2.3	1.5	1.7	2.0	2.4	1.5	1.8	2.1	2.5	1.8	2.1	2.5	3.1
130	1.7	2.0	2.3	2.7	1.7	2.0	2.3	2.8	1.8	2.1	2.5	2.9	2.1	2.5	3.0	3.7
140	2.0	2.3	2.7	3.2	2.0	2.3	2.7	3.2	2.1	2.4	2.8	3.4	2.4	2.9	3.5	4.2
150	2.2	2.6	3.1	3.6	2.3	2.6	3.1	3.7	2.4	2.7	3.3	3.9	2.8	3.3	4.0	4.9
160	2.6	3.0	3.5	4.1	2.6	3.0	3.5	4.2	2.7	3.1	3.7	4.4	3.1	3.8	4.5	5.5
170	2.9	3.3	4.0	4.7	2.9	3.4	4.0	4.8	3.1	3.5	4.2	5.0	3.6	4.3	5.1	6.2
180	3.2	3.7	4.5	5.2	3.3	3.8	4.5	5.4	3.4	3.9	4.7	5.6	4.0	4.8	5.7	7.0
190	3.6	4.2	5.0	5.8	3.7	4.2	5.0	6.0	3.8	4.4	5.2	6.2	4.4	5.3	6.4	7.8
200	4.0	4.6	5.5	6.5	4.1	4.7	5.5	6.6	4.2	4.9	5.8	6.9	4.9	5.9	7.1	8.6
210	4.4	5.1	6.1	7.1	4.5	5.2	6.1	7.3	4.7	5.4	6.4	7.6	5.4	6.5	7.8	9.5
220	4.8	5.6	6.7	7.8	4.9	5.7	6.7	8.0	5.1	5.9	7.0	8.3	6.0	7.1	8.6	10.5
230	5.3	6.1	7.3	8.5	5.4	6.2	7.3	8.7	5.6	6.4	7.7	9.1	6.5	7.8	9.4	11.4
240	5.8	6.7	8.0	9.3	5.8	6.8	8.0	9.5	6.1	7.0	8.4	9.9	7.1	8.5	10.2	12.4
250	6.2	7.2	8.6	10.1	6.3	7.4	8.7	10.3	6.6	7.6	9.1	10.8	7.7	9.2	11.1	13.5
260	6.7	7.8	9.3	10.9	6.9	8.0	9.4	11.2	7.2	8.2	9.8	11.7	8.3	10.0	12.0	14.6
270	7.3	8.4	10.1	11.8	7.4	8.6	10.1	12.1	7.7	8.9	10.6	12.6	9.0	10.8	12.9	15.7
280	7.8	9.1	10.8	12.6	7.9	9.2	10.9	13.0	8.3	9.6	11.4	13.5	9.6	11.6	13.9	16.9
290	8.4	9.7	11.6	13.6	8.5	9.9	11.7	13.9	8.9	10.2	12.2	14.5	10.3	12.4	14.9	18.2
300	9.0	10.4	12.4	14.5	9.1	10.6	12.5	14.9	9.5	11.0	13.0	15.5	11.1	13.3	15.9	19.4

Supersedes 7/07 Issue – Revised Sag Tables

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**167**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**75**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	1.0	1.1	1.3	1.6	2.0	3.4	3.7	4.8
75	2.0	2.4	2.9	3.5	4.4	6.8	7.4	8.9
100	3.7	4.3	5.0	6.1	7.6	11.0	11.9	13.7
125	5.9	6.7	7.9	9.5	11.5	16.1	17.0	19.1
150	8.4	9.7	11.4	13.4	16.2	21.6	22.7	25.1
175	11.6	13.4	15.6	18.4	21.7	28.0	29.2	31.8
200	17.5	20.3	23.6	27.5	31.9	39.2	40.7	43.6
225	26.0	30.0	34.6	39.5	44.5	52.6	54.1	57.1
250	37.8	43.0	48.4	53.9	59.4	67.8	69.4	72.4
275	52.9	58.8	64.7	70.6	76.2	84.7	86.3	89.4
300	70.9	77.2	83.2	89.2	94.8	103.4	105.0	108.2

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½" ICE	**½" ICE**	**6 LB. WIND**	**4 LB. WIND, ½" ICE**
DEAD END SPAN (FEET)				
50	4.3	3.6	1.9	5,085
75	9.2	7.8	4.2	5,401
100	15.4	13.1	7.4	5,751
125	22.7	19.3	11.4	6,111
150	30.8	26.5	16.1	6,469
175	39.8	34.6	21.6	*6,800
200	52.1	46.1	31.0	*6,800
225	66.0	59.3	42.7	*6,800
250	81.6	74.2	56.9	*6,800
275	98.8	91.0	73.1	*6,800
300	117.6	109.4	91.3	*6,800

** Note: Design Specification Constraint*

Supersedes 7/07 Issue – Revised Sag Tables

Supersedes 7/15 Issue – Revised section 16.6.20

16.6 PREASSEMBLED LASHED AERIAL CABLE (PLAC)

Factory assembled shielded aerial cable shall be used as the second circuit on 15 kV pole lines or on those lines that may become 15 kV. It shall also be used where clearance to ground or clearance to buildings is questionable as well as for express feeder applications. In general, the preferred construction shall first utilize open wire crossarm construction followed by armless or spacer cable construction; however, aerial cable may be used as an alternate method to satisfy conditions mentioned above. Factory assembled shielded aerial cable has a grounded metallic sheath and requires similar clearance to that specified for secondary, rather than for primary conductors. The metallic sheath is to be bonded at each splice and termination. Additionally, arresters shall be installed at each termination to provide the best surge protection possible. In order to properly do so, the termination must be placed on a bracket and not hung directly under the disconnect switch as shown on Page 16-320.

There are several standard pre-assembled aerial cables currently available (refer to Section 50 in UG Standards). These cables have a jacketed concentric neutral with 3 phase conductors and a EHS copperweld messenger held together with a covered copper binding tape. Cables have a 5000 lb. design tension. Consult Standards Engineering for Sag tensions and requirements for the larger sizes. Older pre-assembled aerial cable uses a copper tape shielding as opposed to a concentric neutral. The messenger can be utilized as the neutral conductor. The messenger shall be bonded to the secondary neutral, if present, at every pole. The messenger shall be bonded to a driven ground rod a minimum of every 800 feet.

Note: Certain existing circuits may utilize a ½" EHS copperweld messenger that requires either deadending at a pole location for splicing or double deadending to a figure 8 where mid-span splicing is necessary.

16.6.10 Aerial Cable Installation

Factory assembled shielded aerial cable should be pulled in and sagged as follows:

(a) Use large blocks at every pole with auxiliary roller near the cable reel to minimize bending of the cable.

(b) Have provisions for braking the cable reel.

(c) Pull in the cable using sufficient tension so that the cable is not bent sharply at any block.

(d) Pull the messenger to 5,000 lbs.

(e) Inspect deadends, angles, and guys. If guys have slipped or seriously cut into the wood, tighten, replace, or repair the fittings, then re-stress the messenger as in (d) above.

(f) Reduce the tension to the values specified (Pages 16-54 thru 16-56), clamp the messenger at each pole and complete the dead ends.

16.6.20 Cold Shrink Splices

Newer aerial cables are designed with a jacketed concentric neutral. Older aerial cables are copper tape shielded and unjacketed. For copper tape shielded, unjacketed cable, place a tape marker on the copper tape at the distance given in the instructions for the jacket cutback. Then make all other measurements from this tape marker.

Both splices and terminations shall be cold shrink. Each splice is to be externally bonded. Splice kits (Std. Item UR51_) have carbon black in the splice jackets making them UV resistant therefore no additional steps are required to protect splices from UV rays. Follow the instructions included in the kits for installing the splice and for grounding and bonding.

16.6.30 Aerial Cable Splice Installation – Cable Preparation

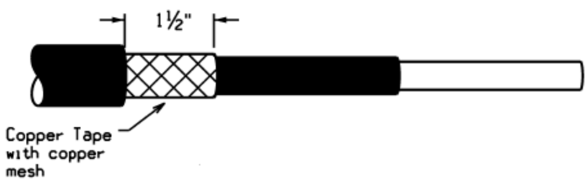
Copper Tape Shield

The instructions packed with the kit are for jacketed concentric neutral (JCN) cable. Use the kit instructions with the following modifications for copper tape shielded aerial cable.

Make the copper tape cutback with the same dimensions shown in the kit for jacketed concentric neutral and flat strap cables. Apply copper tape strip over end of shield. Apply four layers of copper mesh over copper tape and tie back

For unjacketed cable, place a tape marker on the copper tape shield at the dimension given in the instructions for the jacket cutback. Then make all other measurements from this tape marker.

Cut the copper tape shield to 1 ½” beyond the cable jacket cutback. Be careful not to damage the semicon layer**.**

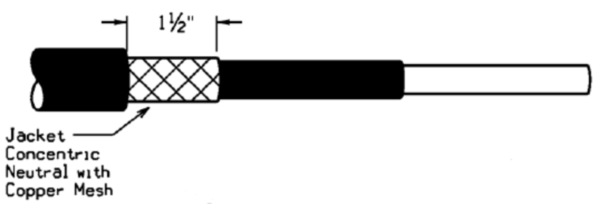


Wrap the copper tape shield with 4 layers of copper mesh and tie off.

Jacketed Concentric Neutrals

The instructions packed with the kit are for jacketed concentric neutral (JCN) cable.

Lift concentric neutrals or drain wires. Wrap 4 layers of copper mesh onto the semicon. Lay the neutrals back down. Refer to Figure 4.



Cover with 4 additional layers of copper mesh and tie off. Refer to Figure 5.

16.6.40 Aerial Cable Splice Installation – Splice Building and Bonding

1. Cut the concentric neutrals / drain wires and apply copper mesh on both sides of the splice to a convenient length as shown on section 36.7.20.

2. Connect the ends of each cable with the proper connector sized to the conductors. Compression connectors are to be used with heat shrink, pre-molded and hand taped splices. Shear bolt connectors are approved for use with cold shrink splices only. For compression connectors make sure to allow an expansion gap from the edge of connector and half the length of the connector for each side as indicated in the instructions. Shear bolt connectors are installed butting the insulation, no expansion gap required. Refer to Figure 19

Supersedes 7/15 Issue – Edited 16.6.30 and 16.6.40 title and content

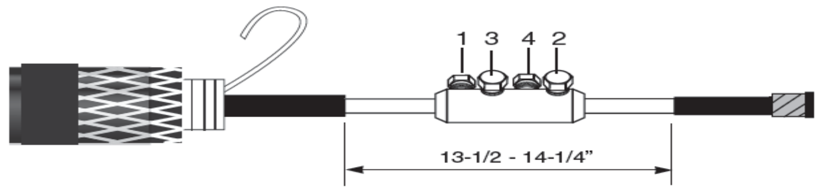


Figure 19

3. Place marking tape on one side of the cable as indicated in the instructions. Position the splice body so that the silicon's edge is lined up with the marking tape Refer to Figure 20.

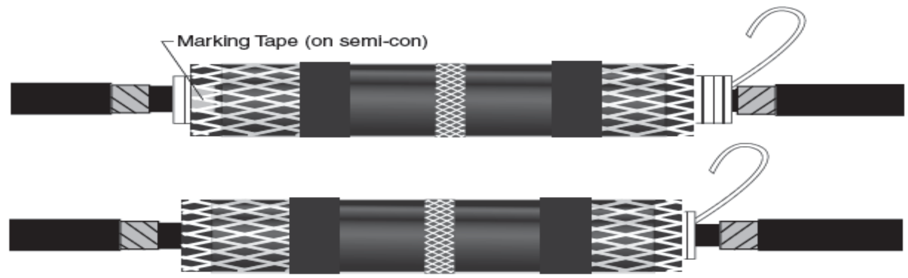


Figure 20

4. Pull the cord counterclockwise while holding the splice body in place. Do not pull the spiral holdout all at once. Slowly pull the spiral holdout on top of the cable then around and underneath until the cord has been completely removed. Refer to Figure 21.

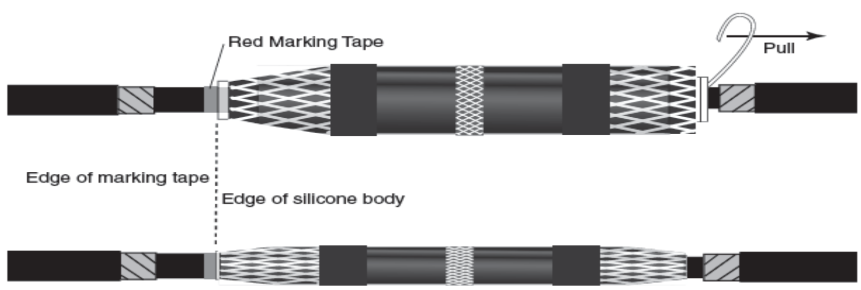


Figure 21

5. Roll out the ground sock on each side of the splice. Lay the ground sock over the metallic shield end of the cables and connect with spring clamps included in the splice kit. Connect copper braid to system ground. Refer to Figure 22

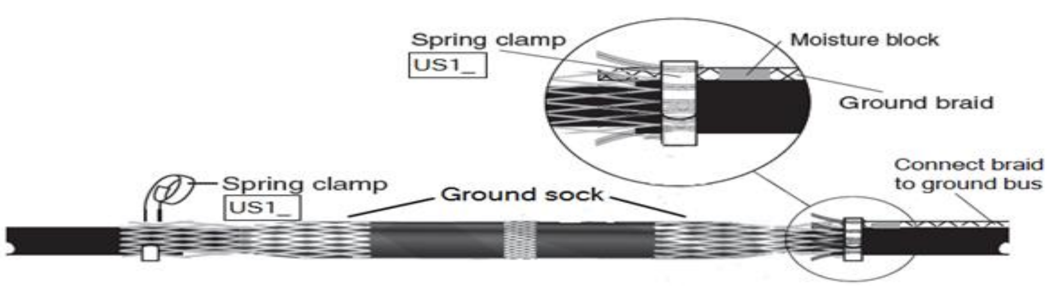


Figure 22

Supersedes 7/15 Issue – Text Shift. Renumbered Page

As of March 2015, cold shrink splice Raychem /TE models (Std. Item UR51_) come with a tinned copper ground sock that runs the length of the splice and overlaps the cable on both sides. Connections to cable neutrals are made with constant force springs laid over the sock and neutrals at each side with a single #2 copper tinned ground braid on one side that exits the splice. This ground braid is connected to the system neutral / driven ground with a single #2 stranded tinned copper conductor (Std. Item W13F) and C crimps (Std. Item S14_). Instructions are included in the kits.

16.6.50 Constant Spring Force Connection Installation

Supersedes 7/15 Issue – Text Shift. Renumbered section 16.6.50.

The **only** acceptable method of braid to shield connection is the following:

1. Clean the copper tape or lead where the connection is to be made.
2. Hold the braid perpendicular to the cable and make at least one complete wrap around the cable. Refer to Figure 15

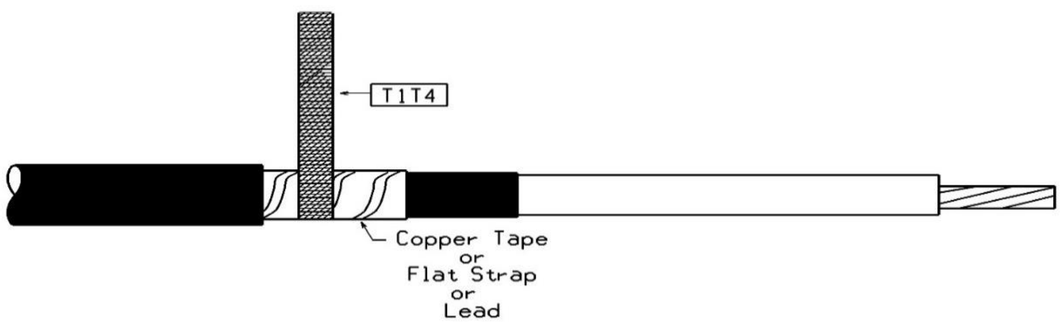


Figure 15

3. Fold the braid over itself at 45 degrees, bringing the long end parallel with the cable. Refer to Figure 16.

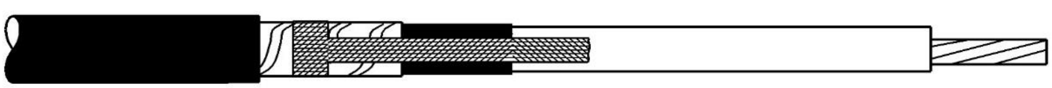


Figure 16

4. Wrap the constant force spring over the braid where it is wrapped around the cable. Use up all of the spring. Refer to Figure 17.

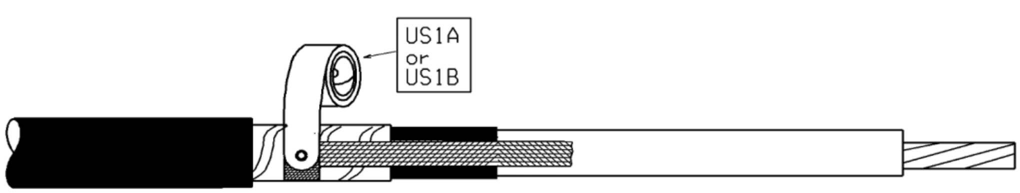


Figure 17

5. If necessary, one to two laps of vinyl tape (Std. Item T2W1) may be placed over the spring to hold it in place. Refer to Figure 18.

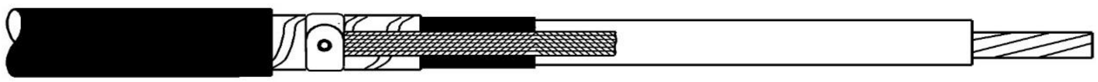


Figure 18

This connection method provides sufficient contact area of the braid to the cable shield and keeps the high resistance spring out of the electrical circuit. The spring is used solely as the mechanical force for the connection.

The traditional method of connecting the braid to the copper tape or lead has been to place one wrap of the constant force spring around the cable, then lay the braid over the spring parallel to the run of cable and then continue wrapping the spring around the cable until all the spring is used up. This connection depends on the spring to carry current from the cable shield to the braid, since the spring is the only material in contact with the shield. **This practice is no longer acceptable as** the spring steel has a relatively high resistance.

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Supersedes 7/07 Issue – Renumbered Page

16.6.60 **Terminations For Copper Tape Shield**

In order to adapt the termination kit for use on cables rated for 5 kV through 25 kV with copper tape shield, an accessory kit will be necessary. This kit contains a solder blocked ground braid and constant force spring. Follow the instructions below for preparation of the cable and installation of the ground braid. The instructions packed with the accessory kit are for a different type of cable.

Select the accessory kit based upon the O.D. over the shield of the cable, as listed in the following table.

Table 3

Shield O.D.	Accessory Kit (Std. Item)
0.82” – 1.63”	UR47T4
1.15” – 2.42”	UR47T5

If the cable has fabric or tape semi-con, this material shall be cut back ¼ - ½ inch more than specified here-in for extruded semi-con layers. The exposed portion of the fabric tape semi-con shall then be wrapped with semi-con tape (Std. Item T1S) applied half lapped, until the specified semi-con cutback is reached. This tape shall then be trimmed square to the cable at the required cutback.

A. Prepare Cable:

1. Check to be sure cable size fits within kit range as shown in Table 1 (cover page) of the termination instructions packaged with the kit.

2. Prepare cable using dimensions shown in Figure 19. Be sure to allow for the depth of the terminal lug and growth of Aluminum Lug (if used – see chart below). If necessary to prevent tape shield from unraveling, TEMPORARILY hold down the edge with a single wrap of vinyl electrical tape.

Table 4

Aluminum Cable Size	#2 – 350 kcMil	400 – 650 kcMil	750 – 1000 kcMil
Growth Allowance	0.25”	0.50”	0.75”

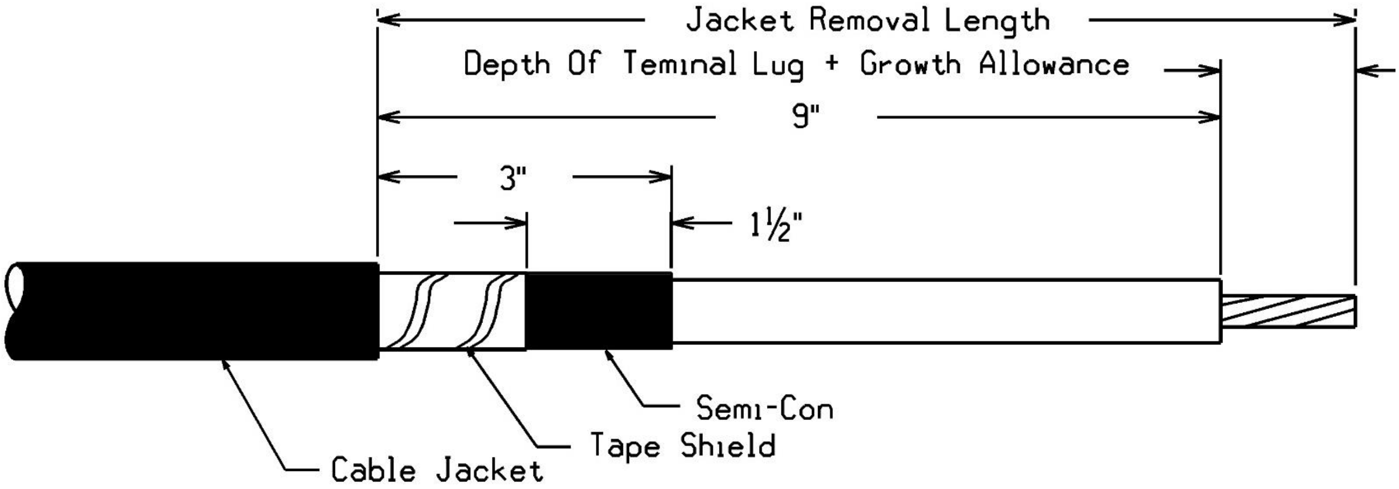


Figure 19

B. Install Ground Braid:

1. Select one of the mastic strips from the termination kit and remove the white release liners. Using light tension, apply a single wrap of mastic around the cable jacket ¼ inch from the cut edge. Cut off excess mastic. See Figure 20.

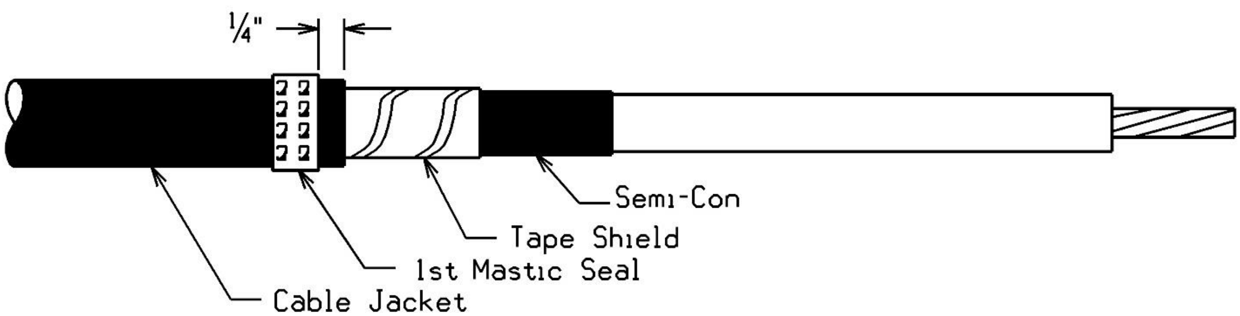


Figure 20

2. Position pre-formed "U" shaped ground braid over tape shield directly adjacent to the cable jacket cut edge. The long tails should extend over the cable jacket, with the solder block of one tail positioned over the mastic. Secure this tail to the cable jacket with a vinyl tape marker, located 4½ inches from the edge of the cable semi-con. See Figure 21.

   Note: Position this vinyl tape with care as it will serve as the marker for final termination location on the cable.

Supersedes 7/07 Issue – Renumbered Page

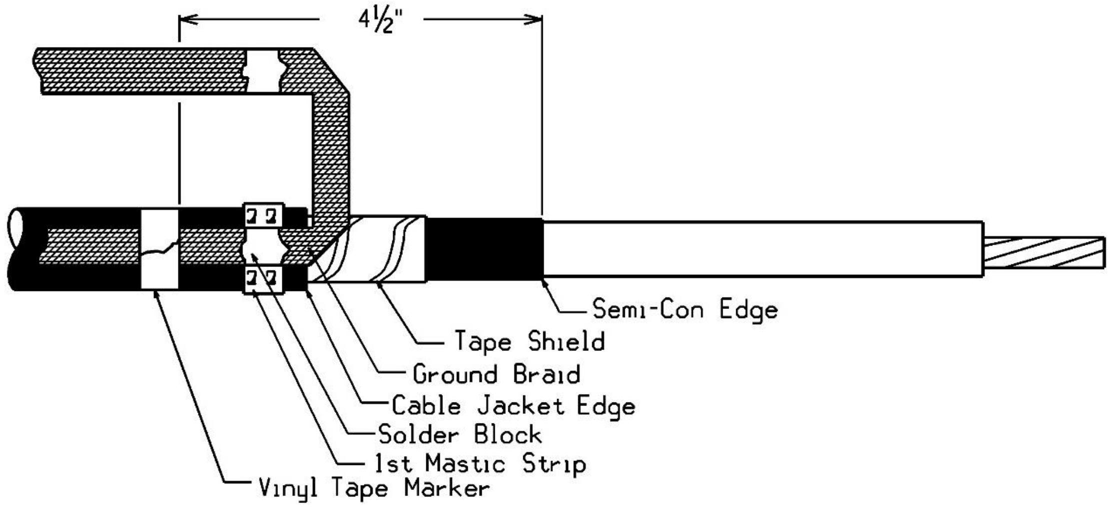


Figure 21

3. Wrap the ground braid around the tape shield and secure with a constant force spring. Using the second mastic strip from the termination kit, remove the liners and wrap mastic over the solder blocks and the first mastic strip. If the solder blocks overlap each other, mastic must be applied between the solder blocks as well as over them. See Figure 22.

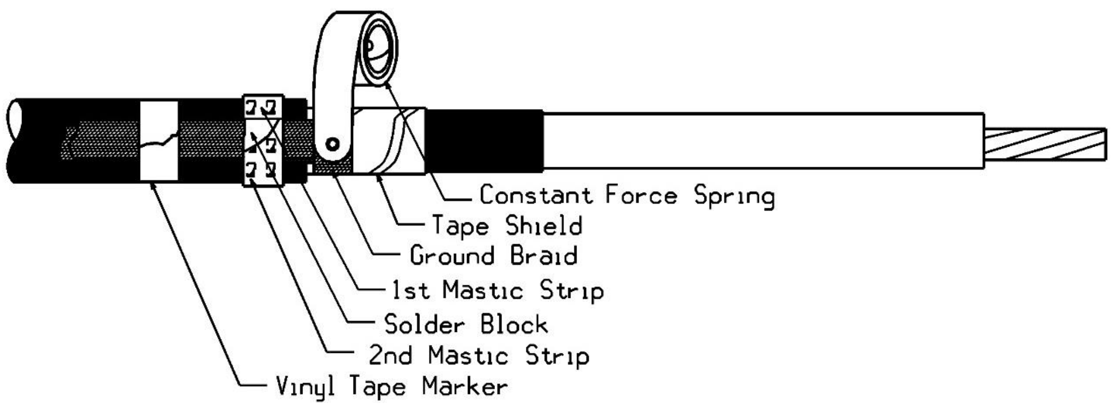


Figure 22

4. Wrap two half-lapped layers of vinyl tape around the mastic seal, constant force spring and exposed metallic shield. Do not allow the vinyl tape to lap onto the cable semi-con. **Note:** If vinyl tape was used to hold the copper tape in place in Step 2, remove it just prior to applying this tape. See Figure 23.

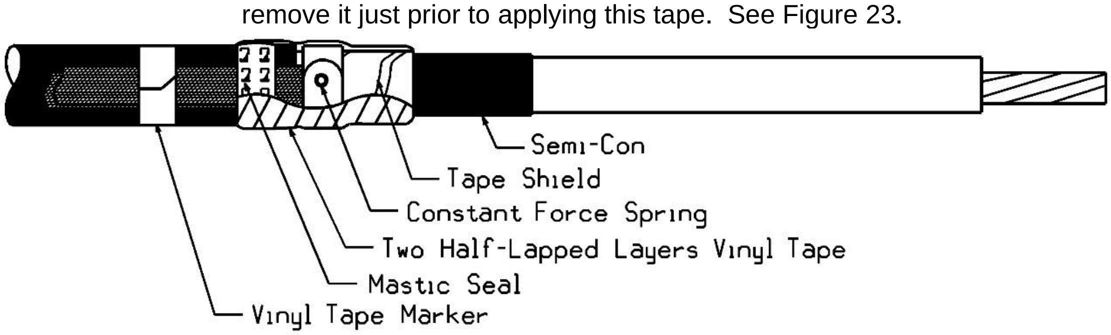


Figure 23

Supersedes 7/07 Issue – Renumbered Page

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	*16890 lbs.	TRANSVERSE	2.5251 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	*0.1145 sq. in.	VERTICAL	7.307 Lb/Ft			
R. (@ 25˚C)	0.0526 Ω / 1000’	TOTAL	8.031 Lb/Ft	359	NORMAL	577
R. (@ 75˚C)	Ω / 1000’			446	EMERGENCY	626
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	19.06˚			
MESSENGER DIAMETER	0.4330”					
COMPLETE DIAMETER	2.5655”					
SYSTEM WEIGHT	3,834 lbs / 1000’					

Note: Quantities identified with an “ * “ are for the messenger only. All other quantities are specified for the complete spacer cable system.

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	2.76	3.12	3.36	3.84	4.44	5.28	5.76	6.24
75	6.24	6.96	7.68	8.52	9.60	11.04	11.76	12.48
100	11.40	12.48	13.68	15.00	16.44	18.36	19.32	20.28
125	18.12	19.80	21.24	23.04	24.84	27.24	28.44	29.64
150	26.64	28.80	30.60	32.76	34.92	37.68	39.00	40.44
175	38.64	41.16	43.44	45.84	48.36	51.48	52.92	54.36
200	53.76	56.64	59.16	61.80	64.44	67.80	69.48	71.04
225	71.52	74.64	77.40	80.16	83.04	86.52	88.20	89.88
250	91.92	95.16	98.04	100.92	103.92	107.52	109.20	110.88
275	114.72	118.08	120.96	123.96	126.96	130.80	132.48	134.28
300	139.92	143.28	146.28	149.40	152.40	156.24	158.04	159.84

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	5.28	5.40	3.72	5647
75	11.40	11.52	8.28	5931
100	19.32	19.44	14.64	6222
125	29.04	29.04	22.56	6496
150	40.20	40.20	32.28	6745
175	54.36	54.24	45.24	*6800
200	70.92	70.80	53.76	*6800
225	89.88	89.76	79.32	*6800
250	110.88	110.76	99.96	*6800
275	134.28	134.16	123.00	*6800
300	159.84	159.72	148.32	*6800
** Note: Design Specification Constraint*				

Supersedes 7/07 Issue – Renumbered Page

PHYSICAL PROPERTIES	
R.B.S.	*16890 lbs.
C.S.A.	*0.1145 sq. in.
R. (@ 25˚C)	0.0526 Ω / 1000’
R. (@ 75˚C)	Ω / 1000’
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)
MESSENGER DIAMETER	0.4330”
COMPLETE DIAMETER	3.228”
WEIGHT	5,010 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	1.409 Lb/Ft
VERTICAL	7.130 Lb/Ft
TOTAL	7.568 Lb/Ft
SWING	11.12˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
333	NORMAL	547
416	EMERGENCY	593

Note: Quantities identified with an “ * “ are for the messenger only. All other quantities are specified for the complete spacer cable system.

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	4894	4596	4353	4111	4783	4536	4336	4136	4688	4485	4320	4155	4610	4442	4306	4169
ACTUAL SPAN (FEET)																
50	3.8	4.1	4.3	4.6	3.9	4.1	4.3	4.6	4.0	4.2	4.4	4.5	4.1	4.2	4.4	4.5
60	5.5	5.9	6.2	6.6	5.7	6.0	6.3	6.6	5.8	6.1	6.3	6.5	5.9	6.1	6.3	6.5
70	7.5	8.0	8.5	9.0	7.7	8.1	8.5	8.9	7.9	8.2	8.6	8.9	8.0	8.3	8.6	8.9
80	9.8	10.5	11.1	11.7	10.1	10.6	11.1	11.7	10.3	10.8	11.2	11.6	10.5	10.9	11.2	11.6
90	12.4	13.3	14.0	14.8	12.7	13.4	14.1	14.8	13.0	13.6	14.2	14.7	13.3	13.8	14.2	14.7
100	15.4	16.4	17.3	18.3	15.7	16.6	17.4	18.2	16.1	16.8	17.5	18.1	16.4	17.0	17.5	18.1
110	18.6	19.8	20.9	22.1	19.0	20.1	21.0	22.1	19.4	20.3	21.1	22.0	19.8	20.5	21.2	21.9
120	22.1	23.6	24.9	26.3	22.7	23.9	25.0	26.3	23.1	24.2	25.2	26.1	23.6	24.5	25.2	26.1
130	26.0	27.6	29.2	30.9	26.6	28.0	29.4	30.8	27.2	28.4	29.5	30.7	27.7	28.7	29.6	30.6
140	30.1	32.1	33.9	35.8	30.8	32.5	34.1	35.8	31.5	32.9	34.3	35.6	32.1	33.3	34.3	35.5
150	34.6	36.8	38.9	41.1	35.4	37.3	39.1	41.0	36.1	37.8	39.3	40.8	36.9	38.2	39.4	40.8
160	39.3	41.9	44.2	46.8	40.3	42.5	44.5	46.7	41.1	43.0	44.7	46.4	41.9	43.5	44.9	46.4
170	44.4	47.3	49.9	52.8	45.5	47.9	50.2	52.7	46.4	48.6	50.5	52.4	47.3	49.1	50.6	52.4
180	49.8	53.0	56.0	59.2	51.0	53.7	56.3	59.1	52.1	54.5	56.6	58.8	53.1	55.0	56.8	58.7
190	55.4	59.1	62.4	66.0	56.8	59.9	62.8	65.8	58.0	60.7	63.1	65.5	59.1	61.3	63.2	65.4
200	61.4	65.4	69.1	73.1	62.9	66.3	69.5	73.0	64.3	67.2	69.9	72.6	65.5	67.9	70.1	72.5
210	67.7	72.1	76.2	80.6	69.4	73.1	76.7	80.4	70.8	74.1	77.1	80.0	72.2	74.9	77.3	79.9
220	74.3	79.2	83.6	88.5	76.1	80.3	84.2	88.3	77.8	81.4	84.6	87.8	79.3	82.2	84.8	87.7
230	81.3	86.5	91.4	96.7	83.2	87.7	92.0	96.5	85.0	88.9	92.4	96.0	86.7	89.8	92.7	95.9
240	88.5	94.2	99.5	105.3	90.6	95.5	100.1	105.1	92.5	96.8	100.7	104.5	94.3	97.8	100.9	104.4
250	96.0	102.2	108.0	114.2	98.3	103.7	108.7	114.0	100.4	105.1	109.2	113.4	102.4	106.1	109.5	113.3
260	103.8	110.6	116.8	123.6	106.4	112.1	117.5	123.3	108.6	113.6	118.1	122.6	110.7	114.8	118.4	122.5
270	112.0	119.3	126.0	133.2	114.7	120.9	126.7	133.0	117.1	122.5	127.4	132.3	119.4	123.8	127.7	132.1
280	120.4	128.2	135.5	143.3	123.3	130.0	136.3	143.0	126.0	131.8	137.0	142.2	128.4	133.1	137.4	142.1
290	129.2	137.6	145.3	153.7	132.3	139.5	146.2	153.4	135.1	141.4	147.0	152.6	137.8	142.8	147.3	152.4
300	138.2	147.2	155.5	164.5	141.6	149.3	156.5	164.2	144.6	151.3	157.3	163.3	147.4	152.8	157.7	163.1

Supersedes 9/09 Issue – Renumbered page

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	3.6	4.1	4.4	5.0	5.6	6.4	7.1	7.6
75	8.4	9.2	10.0	11.0	12.1	13.3	14.3	15.0
100	15.2	16.6	17.8	19.2	20.6	22.2	23.5	24.5
125	24.5	26.3	27.8	29.6	31.4	33.3	34.7	35.8
150	36.1	38.3	40.2	42.1	44.2	46.3	48.0	49.2
175	50.2	52.6	54.7	57.0	59.2	61.5	63.3	64.7
200	66.6	69.2	71.5	73.9	76.3	78.8	80.8	82.2
225	85.4	88.2	90.6	93.2	95.8	98.3	100.4	101.9
250	106.7	109.6	112.1	114.7	117.4	120.1	122.2	123.7
275	130.2	133.2	135.8	138.6	141.2	144.0	146.2	147.8
300	156.1	159.2	161.9	164.8	167.5	170.4	172.6	174.2

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½" ICE	½" ICE	6 LB. WIND	4 LB. WIND, ½" ICE
DEAD END SPAN (FEET)				
50	5.0	4.9	4.2	5431
75	11.2	10.9	9.5	5523
100	19.4	19.2	17.0	5615
125	30.0	29.6	26.9	5698
150	42.7	42.4	39.0	5767
175	57.6	57.1	53.5	5825
200	74.6	74.3	70.2	5872
225	94.0	93.5	89.3	5910
250	115.7	115.1	110.6	5941
275	139.6	139.0	134.3	5967
300	165.7	165.2	160.3	5988

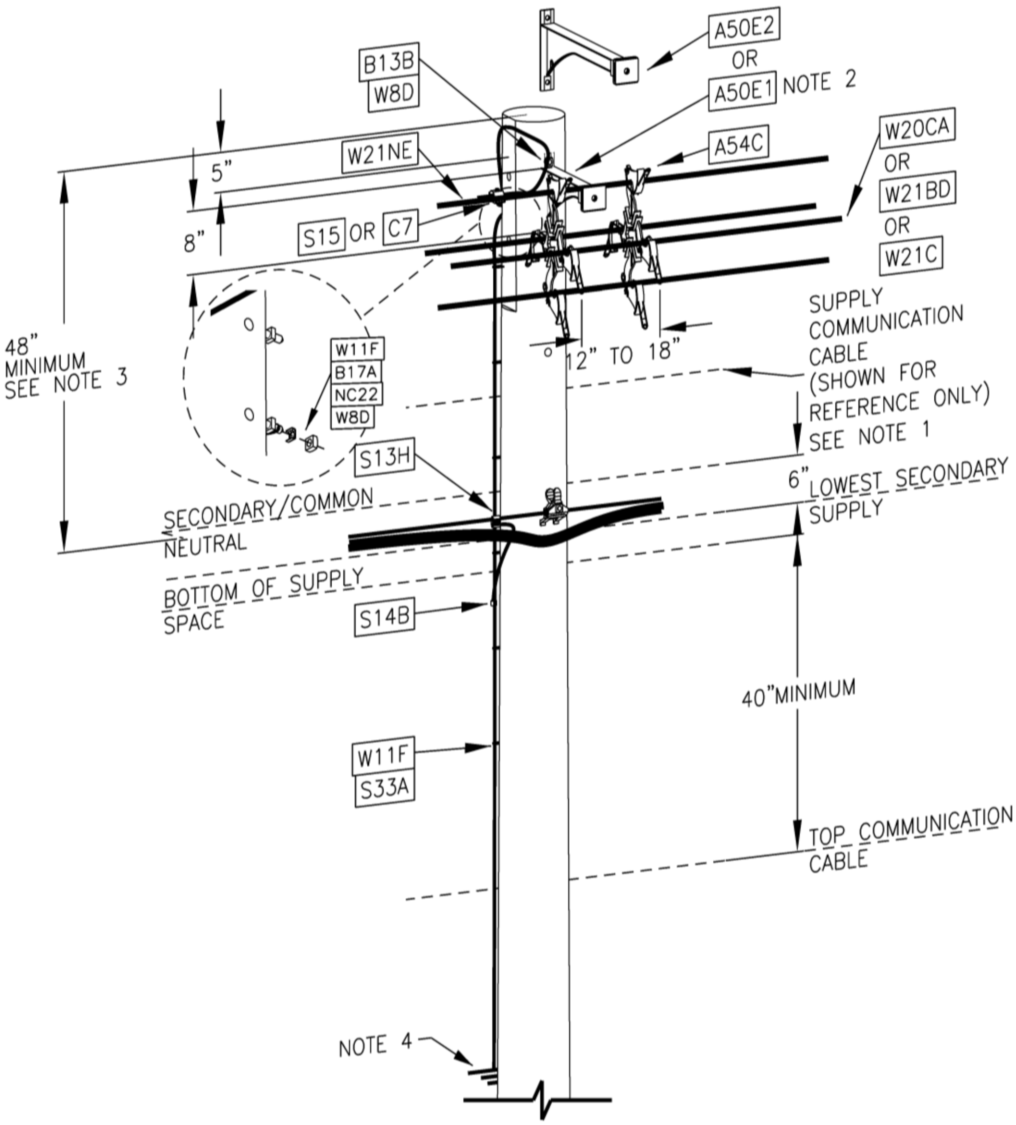
** Note: Design Specification Constraint*

Supersedes 9/09 Issue – Renumbered page

Spacer Cable Construction Drawings

15 kV & Below Grounded Distribution Systems

MU = @16-101B(X)C(Y)	0-15 kV, (X) = Brkt. Length, (Y) = Wire Size



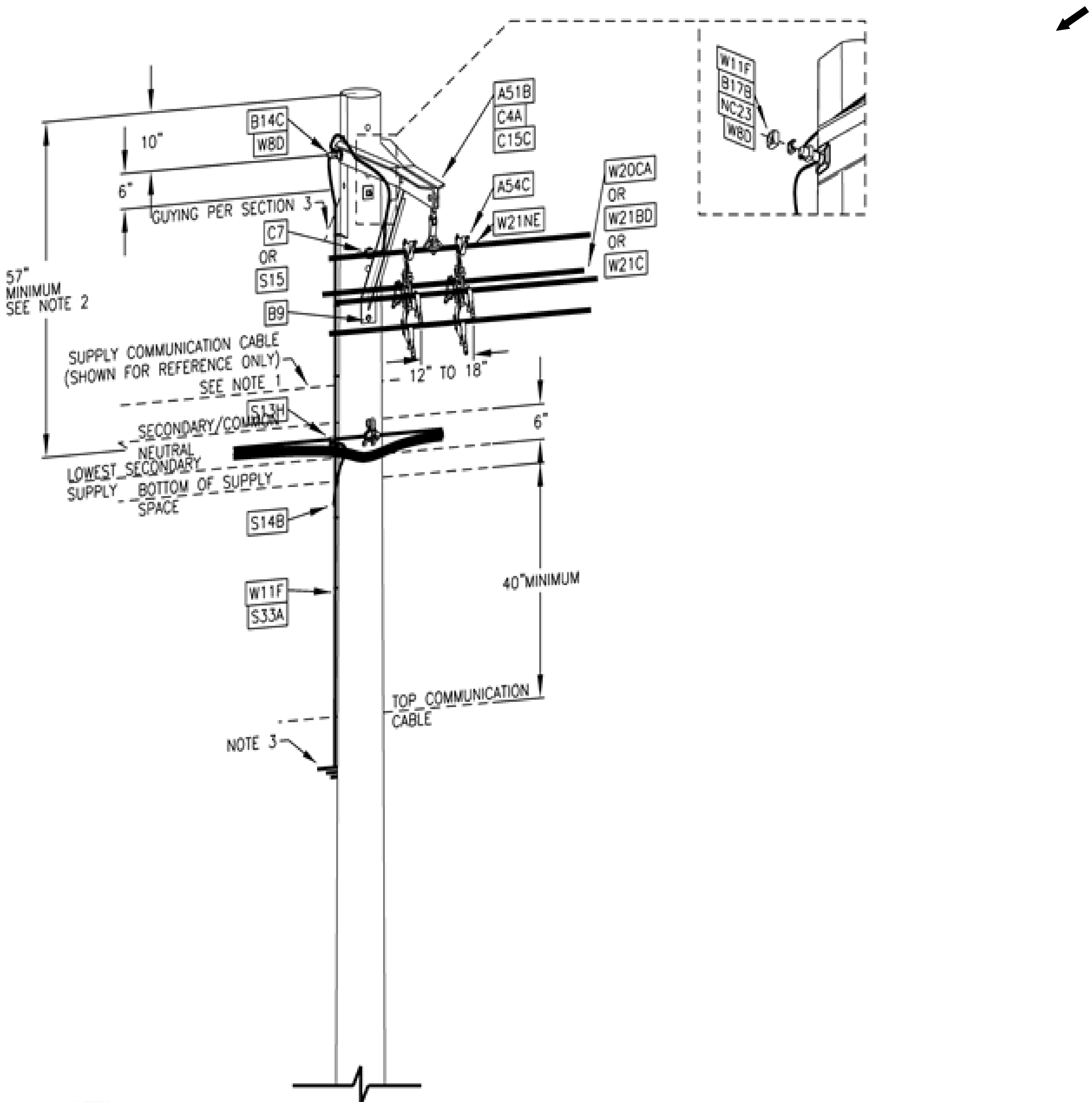
NOTES:
1. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S).
2. FOR REFERENCE PURPOSES, 14" TANGENT BRACKET DESIGN DEPICTED IN INSTALLATION ABOVE (STANDARD ITEM A50E1).
3. MINIMUM DIMENSION SHOWN FOR 1/ø SPACER CABLE CONDUCTOR ON A 40/40 JOINTLY OWNED POLE.
4. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16101	6/30/20

Supersedes 7/15 Issue – Update drawing.

15KV STRAIGHT LINE POLE WITH 14" OR 24" TANGENT MAX. LINE ANGLE 6°

Supersedes 7/15 Issue – Upgraded Drawing

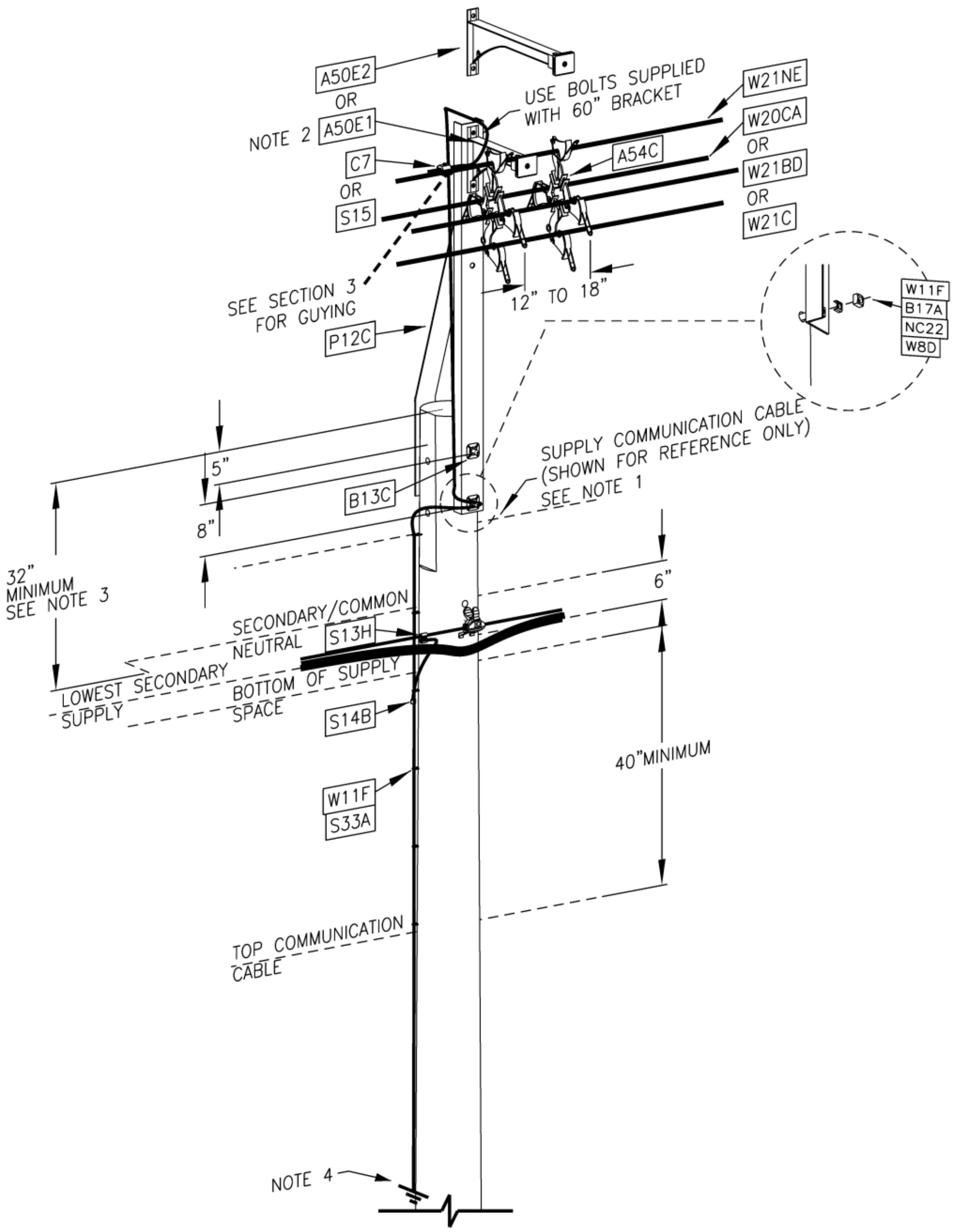


NOTES:

1. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY "POLICY FOR INSTALLING COMMUNICATION CABLE(S). IN THE SUPPLY SPACE."
2. MINIMUM DIMENSION BASED ON 1/ø SPACER CABLE CONDUCTOR ON A 40/40 JOINTLY OWNED POLE.
3. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16102	6/30/20

MU = @16-103B(X)C(Y)	0-15 kV, (X) = Brkt. Length, (Y) = Wire Size



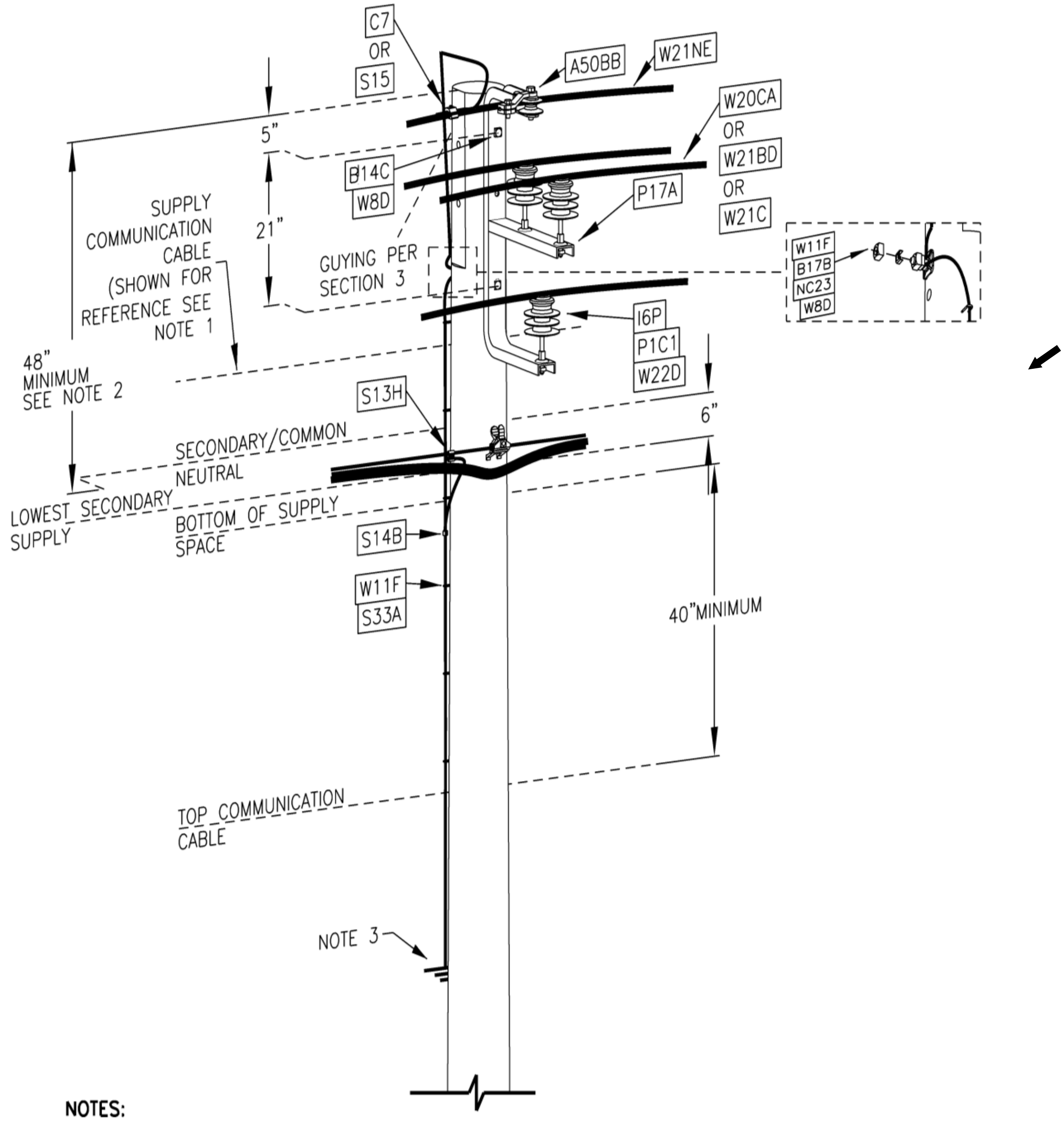
Supersedes 7/15 Issue – Updated 3D Drawing

NOTES:
1. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY "POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE."
2. FOR REFERENCE PURPOSES, 14" TANGENT BRACKET DESIGN DEPICTED IN INSTALLATION ABOVE (STD ITEM A50E1).
3. MINIMUM DIMENSION BASED ON 1/Ø SPACER CABLE CONDUCTOR ON A 40/40 JOINTLY OWNED POLE.
4. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16103	6/30/20

MU = @16-106C(Y) | 0-15 kV (Y) = Wire Size

Supersedes 7/15 Issue – Updated drawing to 3D



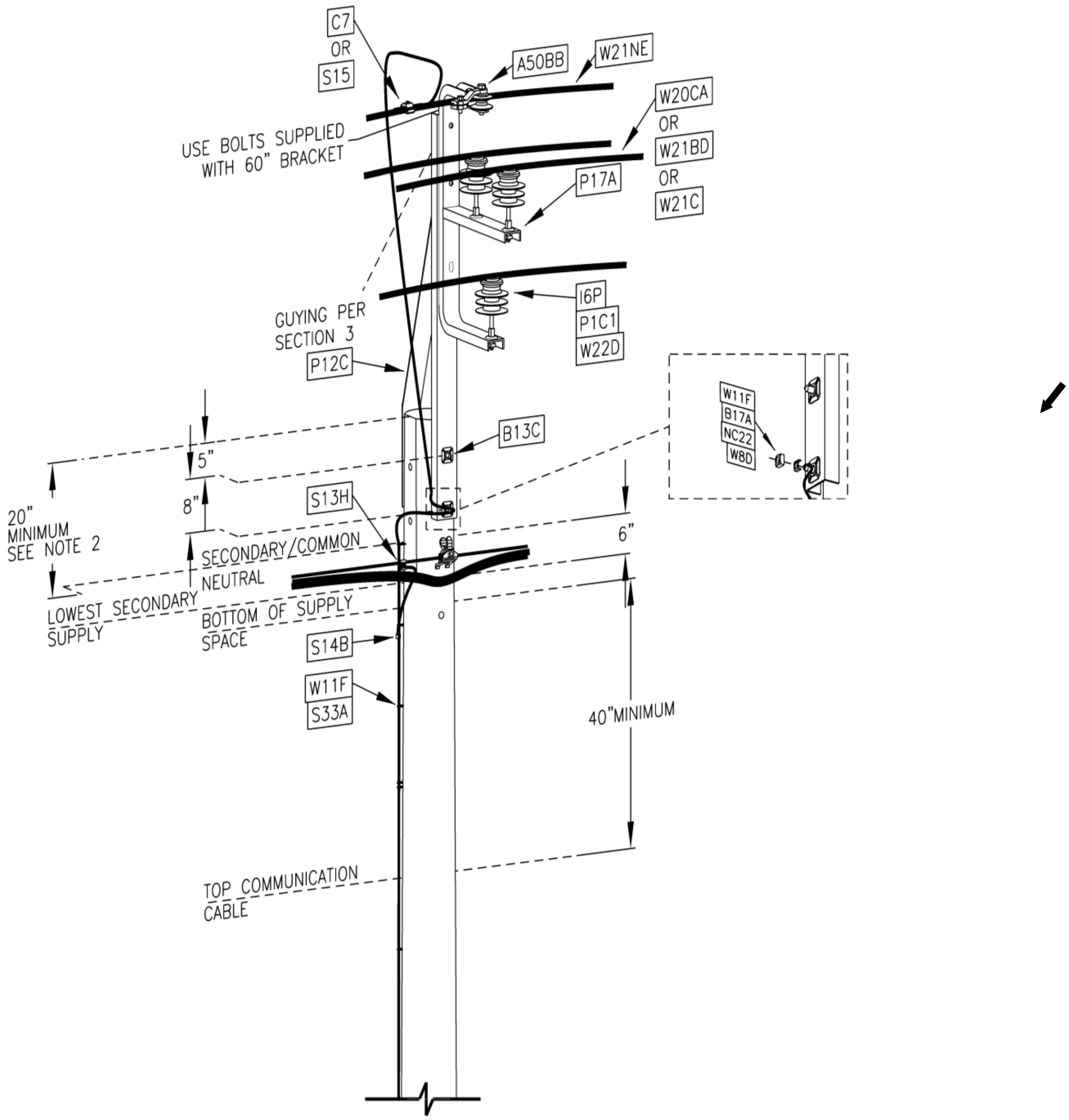
NOTES:

1. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY "POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE."
2. MINIMUM DIMENSION BASED ON 1/Ø SPACER CABLE CONDUCTOR ON A 40/40 JOINTLY OWNED POLE.
3. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16106	6/30/20

15KV LINE ANGLE POLE WITH E – BRACKET
LINE ANGLES 7° - 30°

MU = @16-107C(Y)	0-15 kV (Y) = Wire Size



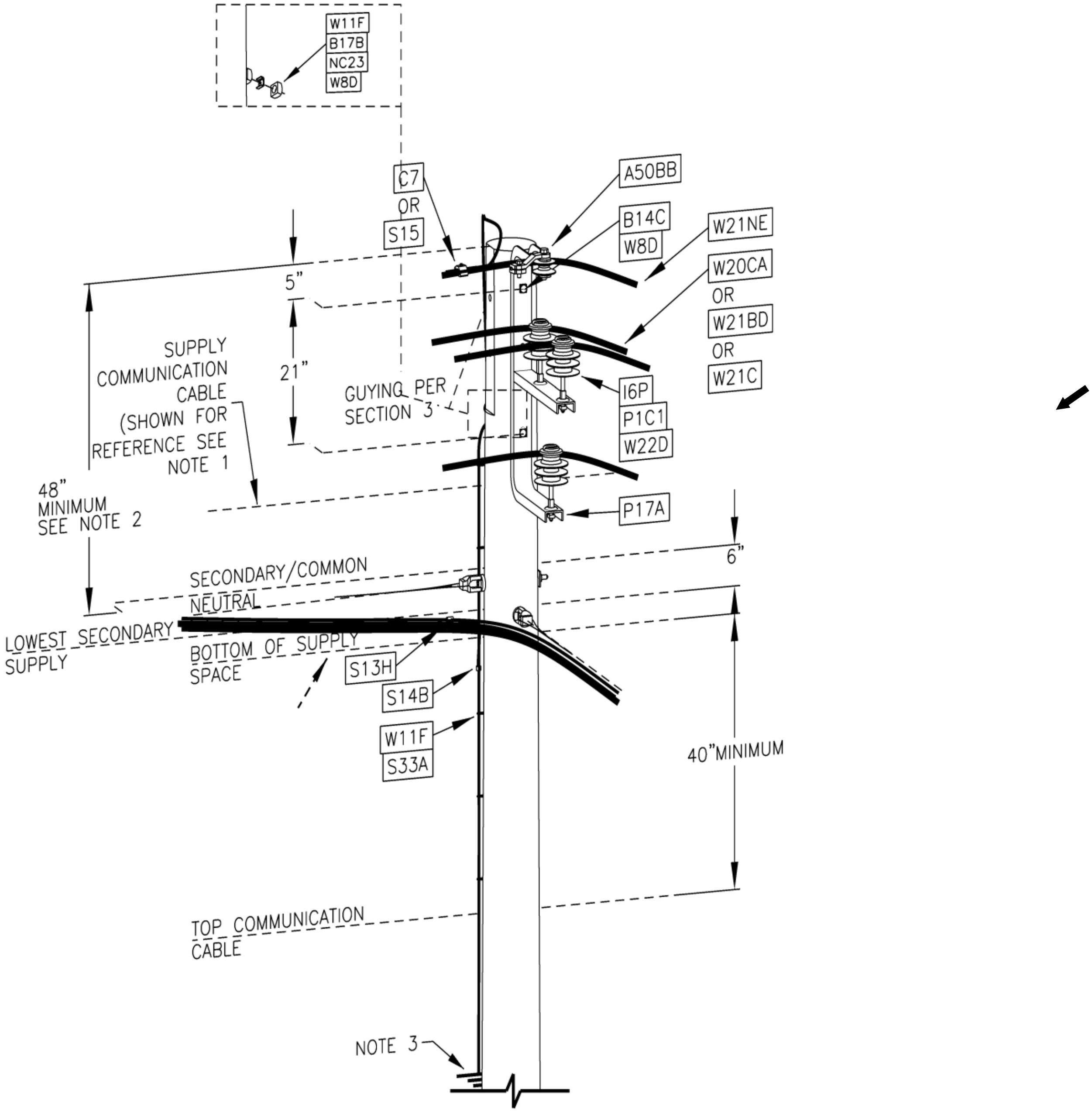
NOTES:

1. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY "POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE."
2. MINIMUM DIMENSION BASED ON 1/ø SPACER CABLE CONDUCTOR ON A 40/40 JOINTLY OWNED POLE.
3. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16107	6/30/20

Supersedes 7/15 Issue – Updated drawing to 3D

15KV LINE ANGLE POLE WITH E – BRACKET ON POLE TOP EXTENSION LINE ANGLES 7° - 30°

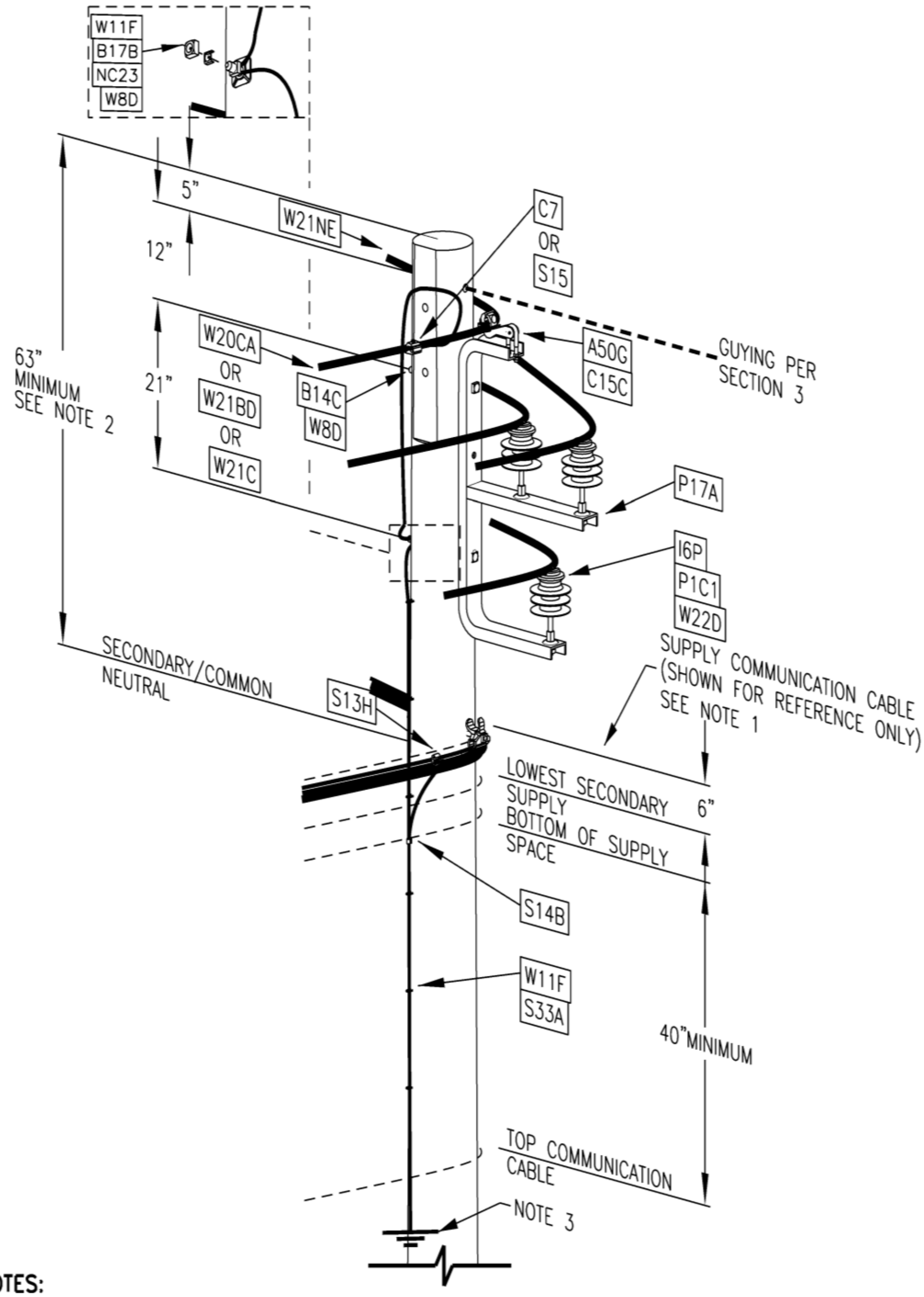


NOTES:
1. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY "POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE."
2. MINIMUM DIMENSION BASED ON 1/Ø SPACER CABLE CONDUCTOR ON A 40/40 JOINTLY OWNED POLE.
3. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16108	6/30/20

15KV LINE ANGLE POLE WITH E – BRACKET – HEAVY CORNER LINE ANGLES 31° - 60°

MU = @16-109C(Y)	0-15 kV (Y) = Wire Size



NOTES:

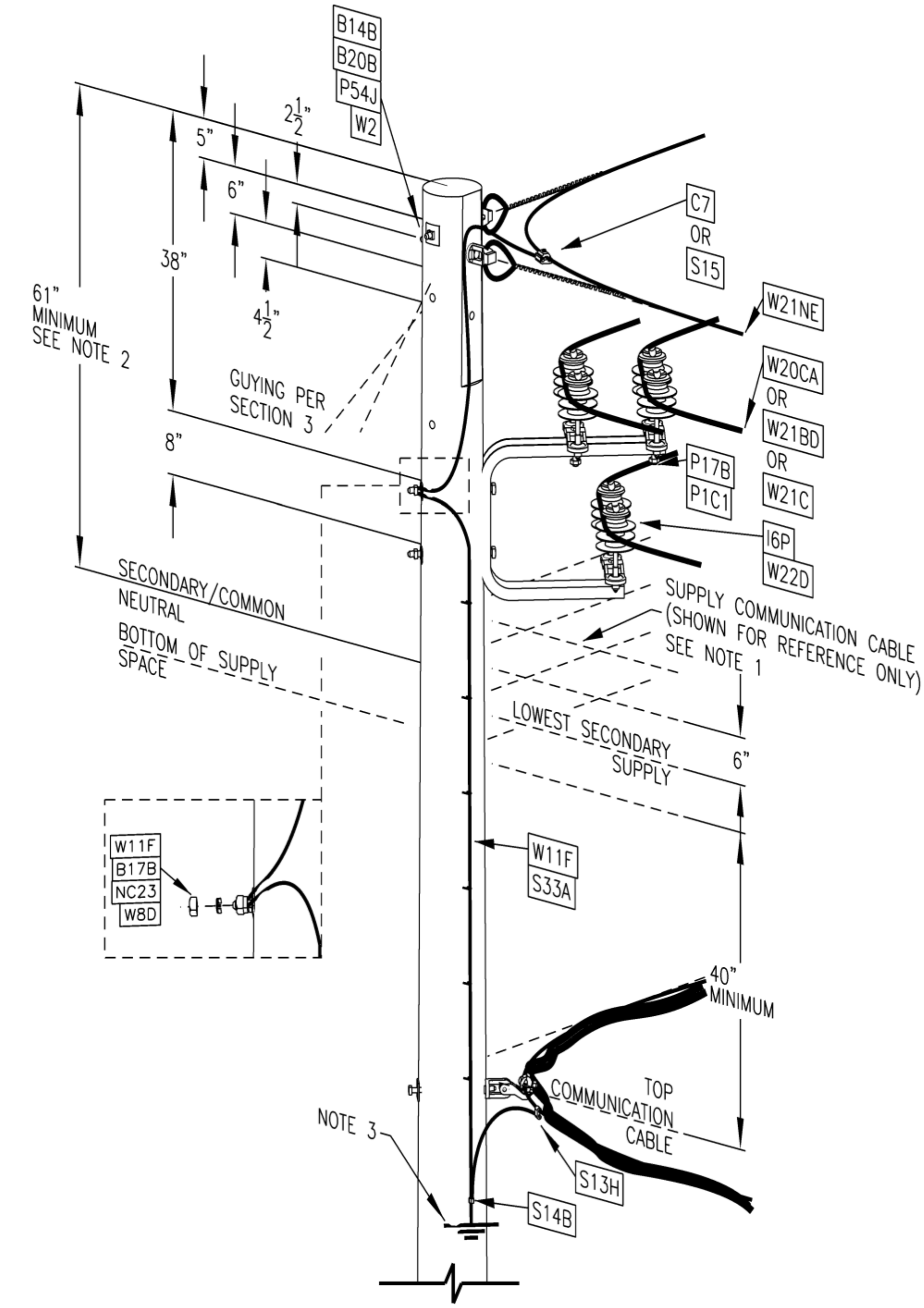
1. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY "POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE."
2. MINIMUM DIMENSION BASED ON 1/Ø SPACER CABLE CONDUCTOR ON A 40/40 JOINTLY OWNED POLE.
3. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16109	6/30/20

Supersedes 7/15 Issue – Updated 3D drawing

15KV LINE ANGLE POLE WITH E – BRACKET – 45° PULL INTO POLE

MU = @16-114C(Y)	0-15 kV (Y) = Wire Size



Supersedes 7/15 Issue – Updated 3D drawing.

NOTES:

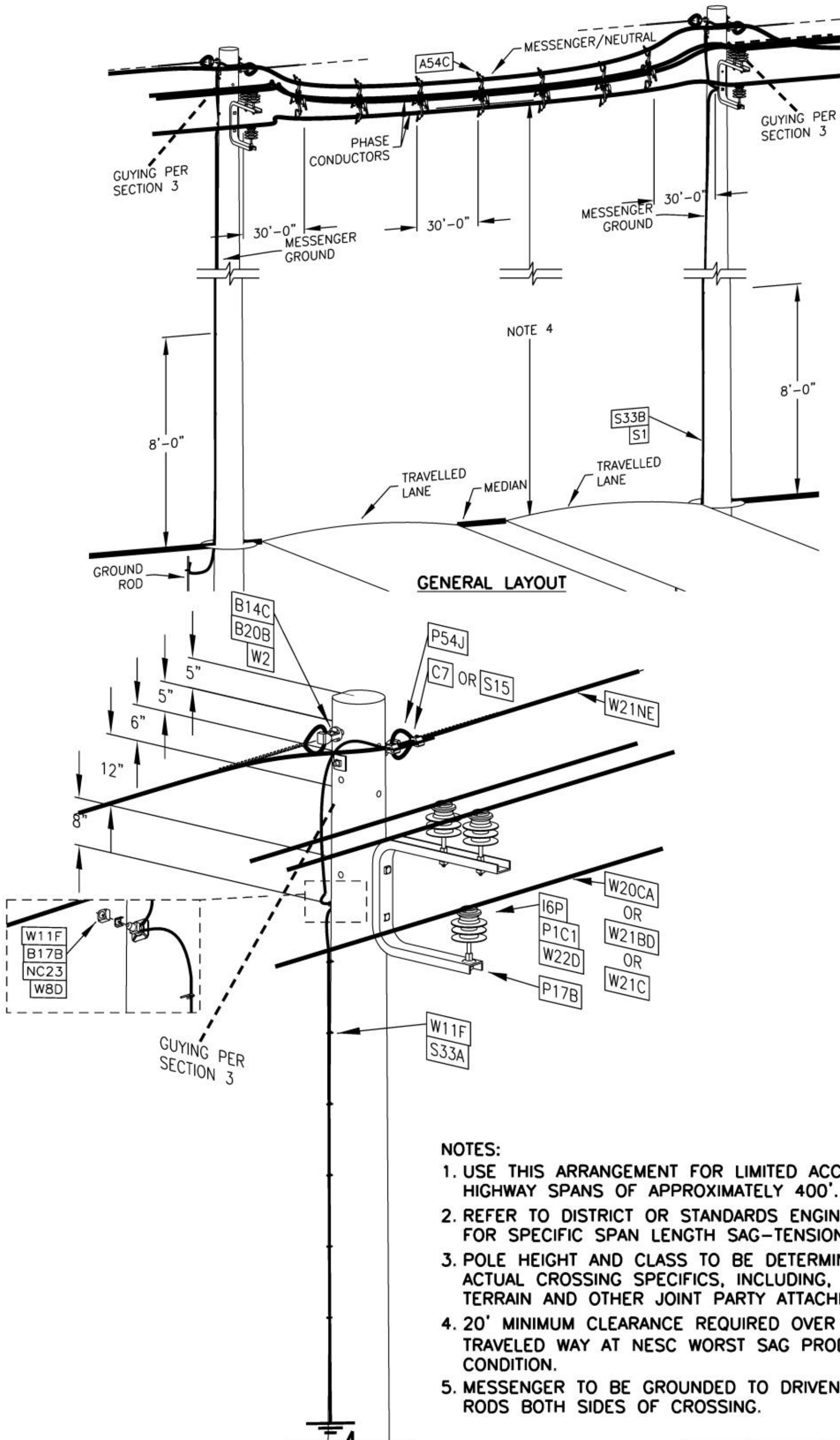
1. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY "POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE."
2. MINIMUM DIMENSION BASED ON 1/Ø SPACER CABLE CONDUCTOR ON A 40/40 JOINTLY OWNED POLE.
3. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16114	6/30/20

15KV LINE POLE WITH C – BRACKET – LINE ANGLES 61˚-90˚

	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
ppl		16-114	7/20

MU = @16-115C(Y)	0-15 kV (Y) = Wire Size



NOTES:

1. USE THIS ARRANGEMENT FOR LIMITED ACCESS HIGHWAY SPANS OF APPROXIMATELY 400'.
2. REFER TO DISTRICT OR STANDARDS ENGINEERING FOR SPECIFIC SPAN LENGTH SAG-TENSION DATA.
3. POLE HEIGHT AND CLASS TO BE DETERMINED BY ACTUAL CROSSING SPECIFICS, INCLUDING, TERRAIN AND OTHER JOINT PARTY ATTACHMENTS.
4. 20' MINIMUM CLEARANCE REQUIRED OVER TRAVELED WAY AT NESC WORST SAG PRODUCING CONDITION.
5. MESSENGER TO BE GROUNDED TO DRIVEN GROUND RODS BOTH SIDES OF CROSSING.

Designer	Drawing	Date
MPR	od16115	6/30/20

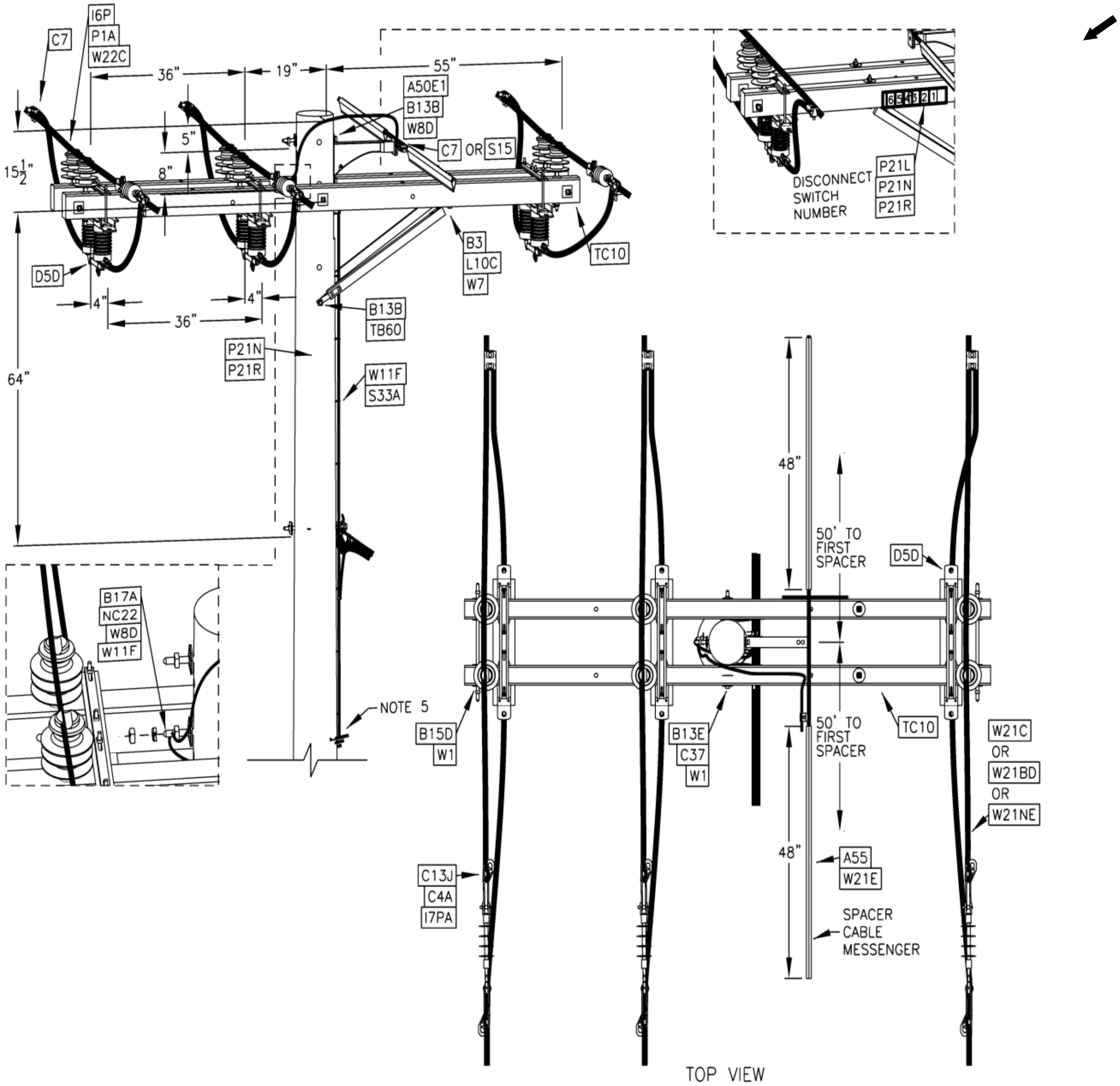
Supersedes 7/15 Issue – Updated 3D drawing

15KV LINE POLE WITH C – BRACKET – HIGHWAY CROSSING POLE

ISSUE	PAGE NUMBER		
7/20	16-115	OVERHEAD CONSTRUCTION STANDARD	ppl

MU = @16-11810D15K	UNDERARM DISC, 0º-10º, 15KV	MU = @16-1181120D15K	UNDERARM DISC, 11º-20º, 15KV

Supersedes 7/09 Issue – Updated 3D drawing



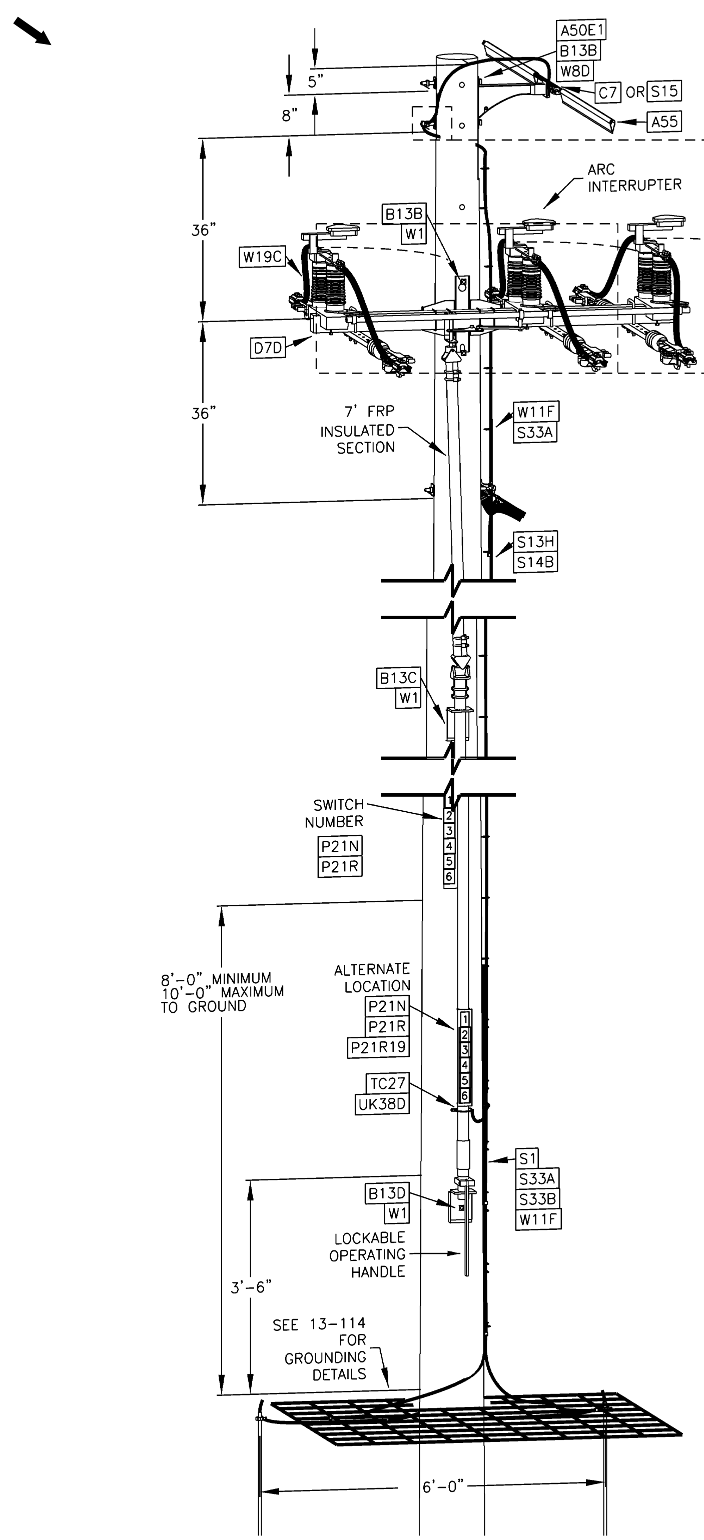
NOTES:
1. WHEN CONNECTING ALUMINUM LUG TO SWITCH PAD, APPLY CONDUCTIVE–GRIT INHIBITING GREASE TO ELECTRICAL SURFACES AND USE STAINLESS STEEL BOLTS.
2. STANDARD PRACTICE IS TO INSTALL SWITCH SO THAT BLADE OPENS AWAY FROM SOURCE AND IS DE- ENERGIZED WHEN OPEN.
3. SWITCH IDENTIFICATION MOUNTED VERTICALLY ON ROAD SIDE PROVIDING MAXIMUM VISIBILITY.
4. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
5. GROUNDING PER SECTION 13.
6. REFER TO SECTION 2.1.30 FOR PHASE AND FEEDER NUMBERING REQUIREMENT

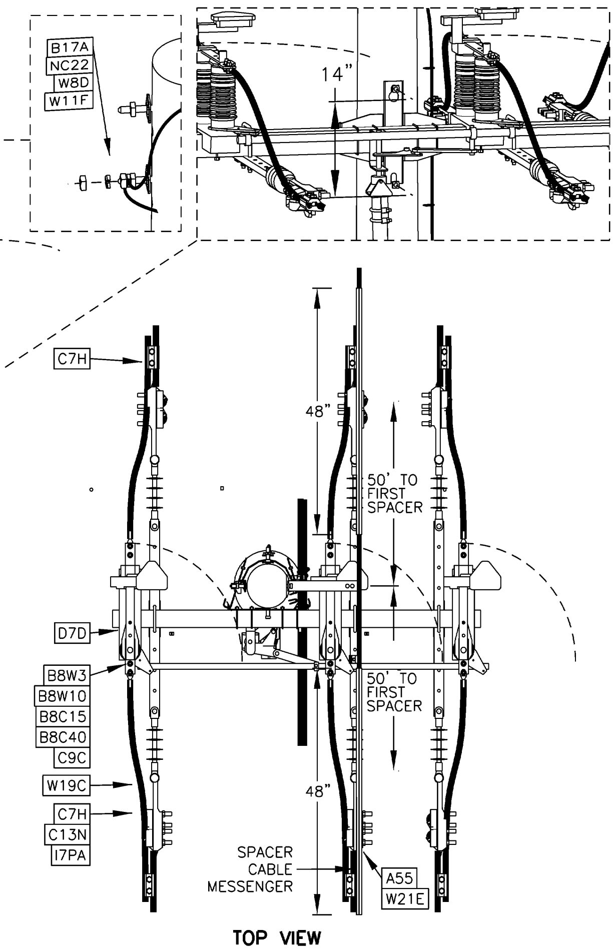
Designer	Drawing	Date
MPR	od16118	6/13/20

15KV UNDERSLUNG 15KV DISCONNECT SWITCH TANGENT LINE AND ANGLES 0˚ - 6˚

MU = @16-122SCLBSW15KV	SC, PREASSB SW LOADBREAK, 15KV

Pole on either side of switch pole must be 40 Ft. Minimum





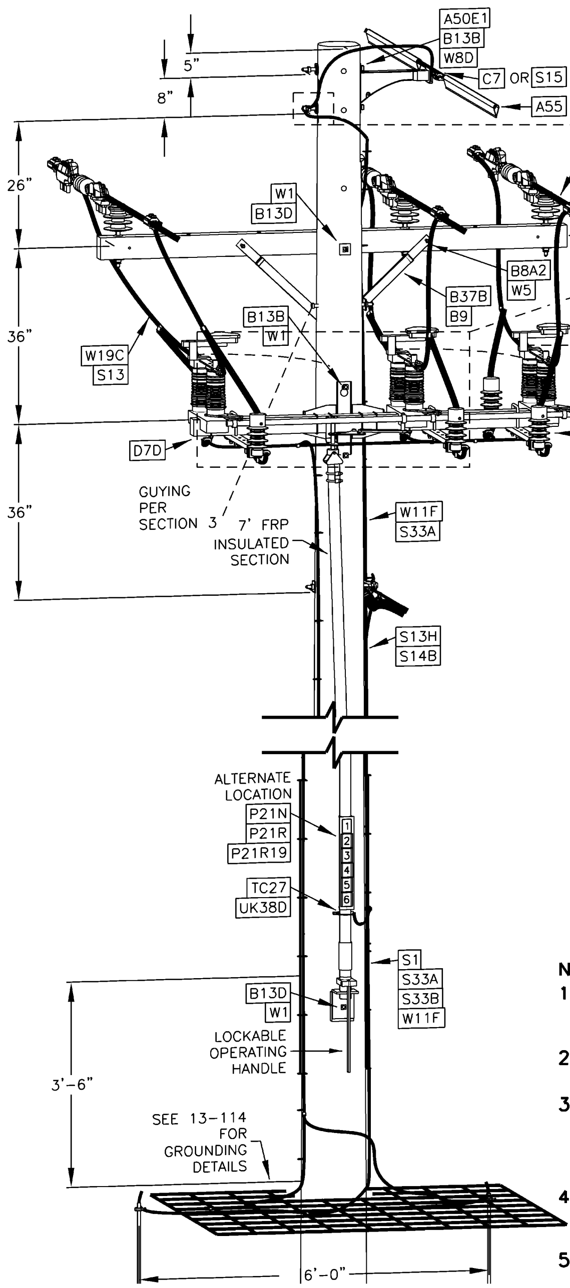
NOTES:

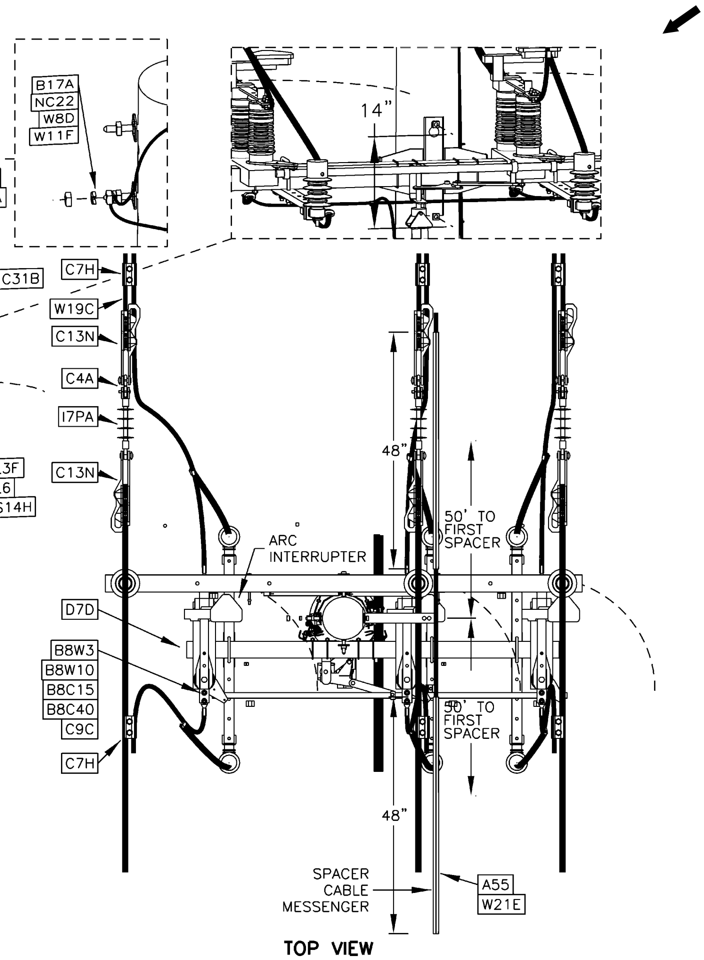
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCHPADS.
3. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE ⅝" THRU BOLTS TO MOUNT OPERATING ROD GUIDES.
4. PRIMARY CONDUCTORS SHALL NEVER BE INSTALLED TO ONLY ONE SIDE OF THE SWITCH AS MAXIMUM DEADEND LOADING WILL BE EXCEEDED.
5. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°.
6. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
7. OPERATING MECHANISM SHALL BE LOCKED IN THE OPEN OR CLOSED POSITION.
8. SWITCH IDENTIFICATION MOUNTED VERTICALLY ON ROAD SIDE PROVIDING MAXIMUM VISIBILITY.
9. POLE ON EITHER SIDE OF SWITCH POLE MUST BE 40'-0" MINIMUM DISTANCE.
10. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od16122	6/30/20

Supersedes 7/09 Issue – Updated 3D drawing

Poles on either side of switch must be 40 Ft. (Minimum)





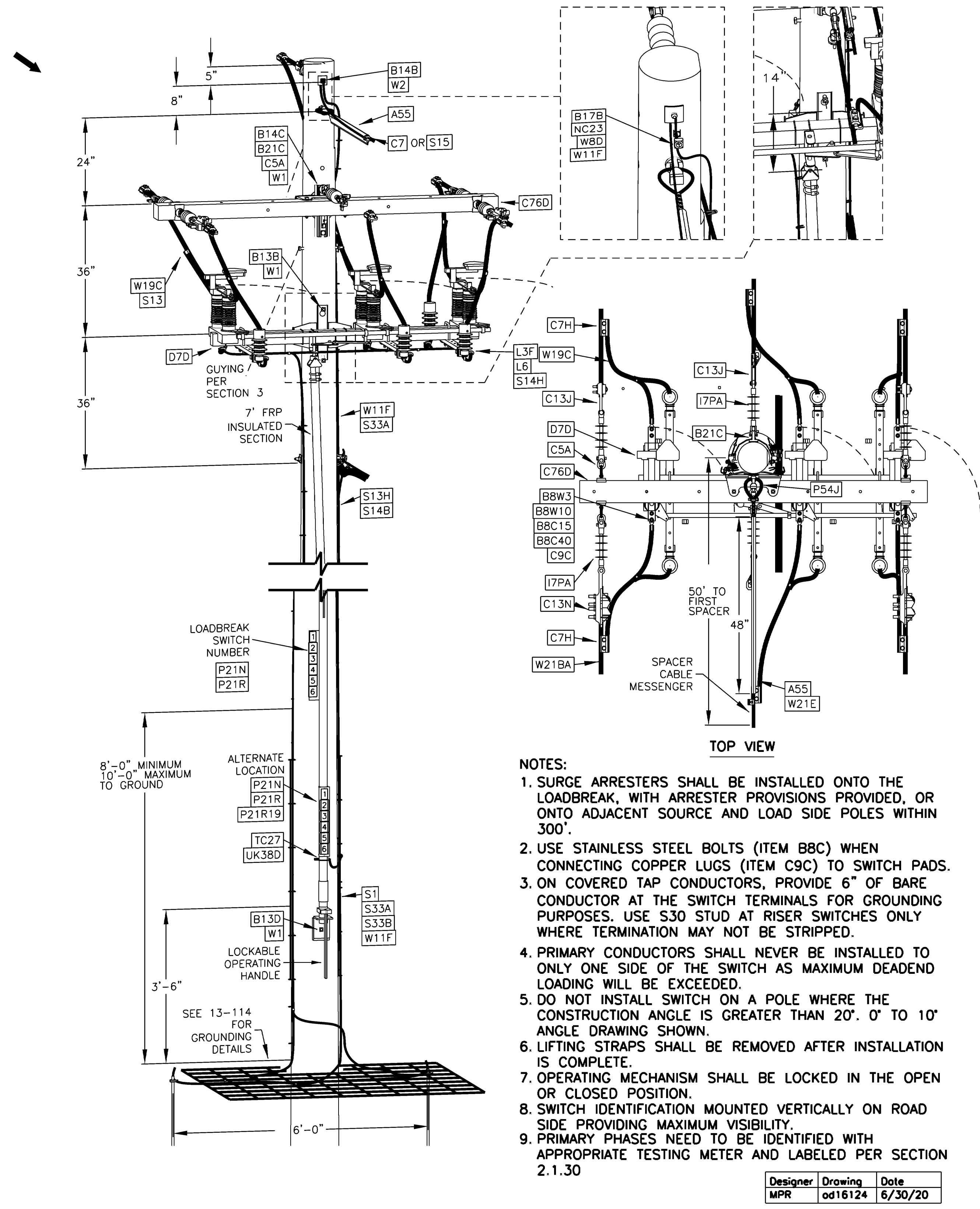
Supersedes 7/09 Issue - Updated 3D drawing

NOTES:

1. SURGE ARRESTERS SHALL BE INSTALLED ONTO THE LOADBREAK, WITH ARRESTER PROVISIONS PROVIDED, OR ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
3. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
4. PRIMARY CONDUCTORS SHALL NEVER BE INSTALLED TO ONLY ONE SIDE OF THE SWITCH AS MAXIMUM DEADEND LOADING WILL BE EXCEEDED.
5. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°. 0° TO 10°ANGLE DRAWING SHOWN.
6. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
7. OPERATING MECHANISM SHALL BE LOCKED IN THE OPEN OR CLOSED POSITION.
8. SWITCH IDENTIFICATION MOUNTED VERTICALLY ON ROAD SIDE PROVIDING MAXIMUM VISIBILITY.
9. POLES ON EITHER SIDE OF SWITCH MUST BE 40'-0" MINIMUM DISTANCE.
10. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od16123	6/30/20

MU = @16-124SCXALBSW15KV | SC – CROSSARM, PREASSB SW, LOADBREAK, 15KV



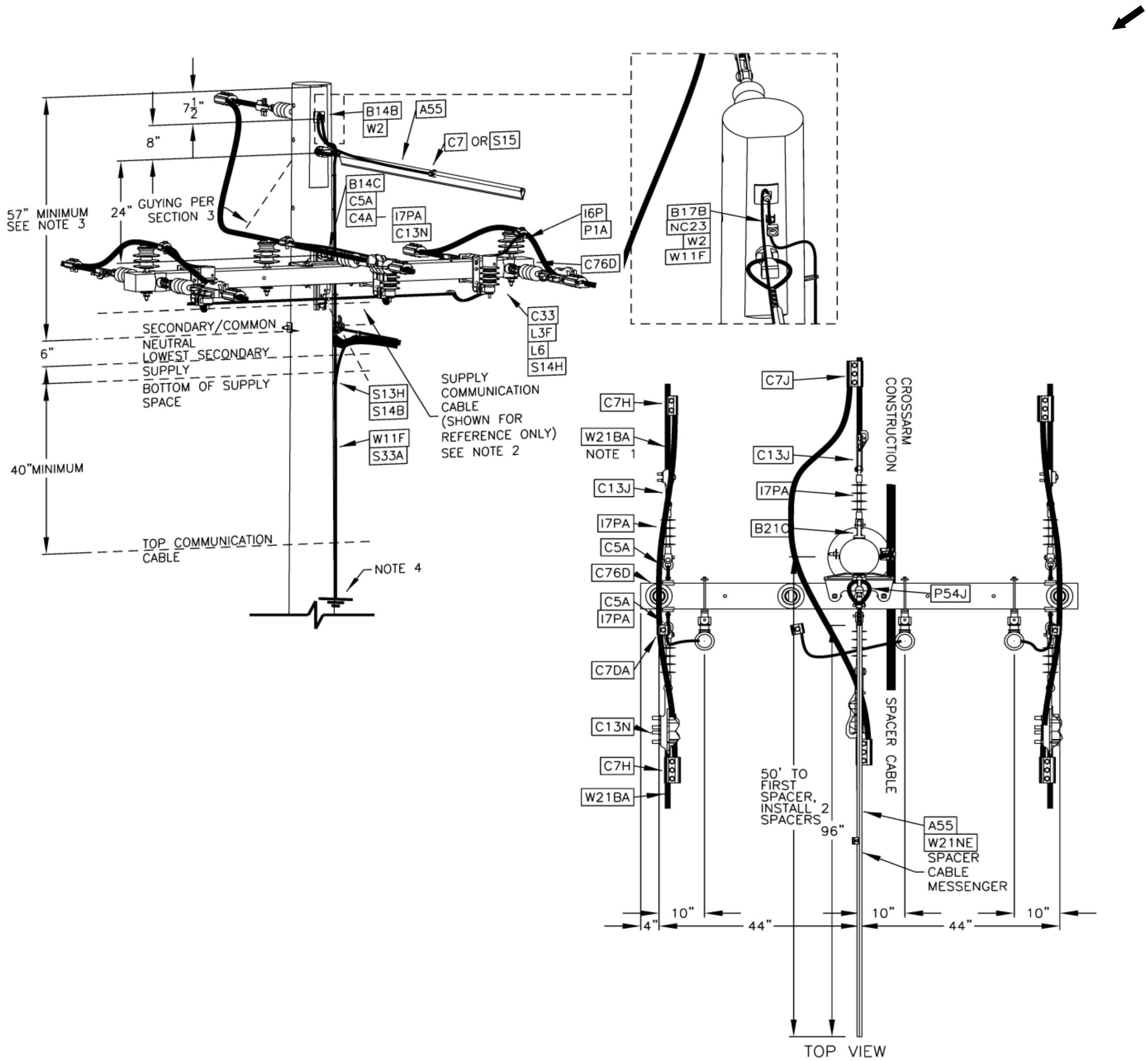
Supersedes 7/07 Issue – Updated 3d drawing

NOTES:

1. SURGE ARRESTERS SHALL BE INSTALLED ONTO THE LOADBREAK, WITH ARRESTER PROVISIONS PROVIDED, OR ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
3. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE S30 STUD AT RISER SWITCHES ONLY WHERE TERMINATION MAY NOT BE STRIPPED.
4. PRIMARY CONDUCTORS SHALL NEVER BE INSTALLED TO ONLY ONE SIDE OF THE SWITCH AS MAXIMUM DEADEND LOADING WILL BE EXCEEDED.
5. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°. 0° TO 10° ANGLE DRAWING SHOWN.
6. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
7. OPERATING MECHANISM SHALL BE LOCKED IN THE OPEN OR CLOSED POSITION.
8. SWITCH IDENTIFICATION MOUNTED VERTICALLY ON ROAD SIDE PROVIDING MAXIMUM VISIBILITY.
9. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od16124	6/30/20

15KV PREASSEMBLED LOADBREAK SWITCH – SPACER CABLE TO CROSSARM CONSTRUCTION DEADEND – HORIZONTAL MOUNTED



Supersedes 7/20 Issue – Updated 3D drawing

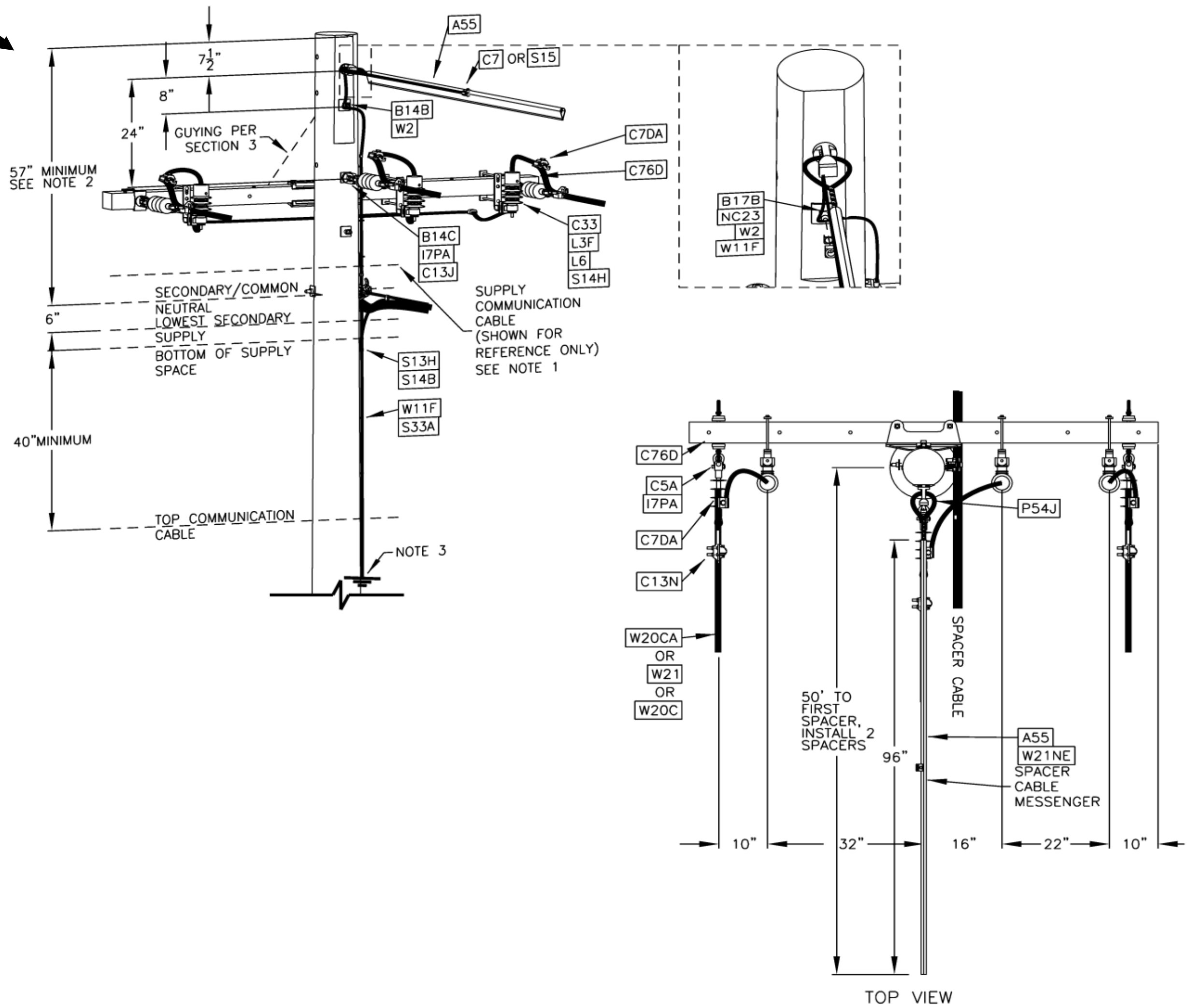
NOTES:

1. DRAWING AND MATERIAL LIST DEPICT A USE OF 477 BARE ALUMINUM CONDUCTOR.
2. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S), SEE COMPANY POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE.
3. MINIMUM DIMENSION BASED ON 40/40 JOINTLY OWNED POLE.
4. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16126	1/15/21

15KV LINE POLE – DEADEND – SPACER CABLE TO CROSSARM CONSTRUCTION

MU = @16-127C(Y)	0-15 kV (Y) = Wire Size



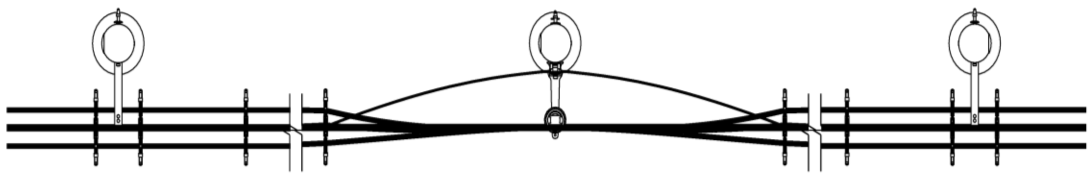
NOTES:

1. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S), SEE COMPANY POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE.
2. MINIMUM DIMENSION BASED ON 40/40 JOINTLY OWNED POLE.
3. GROUNDING PER SECTION 13.

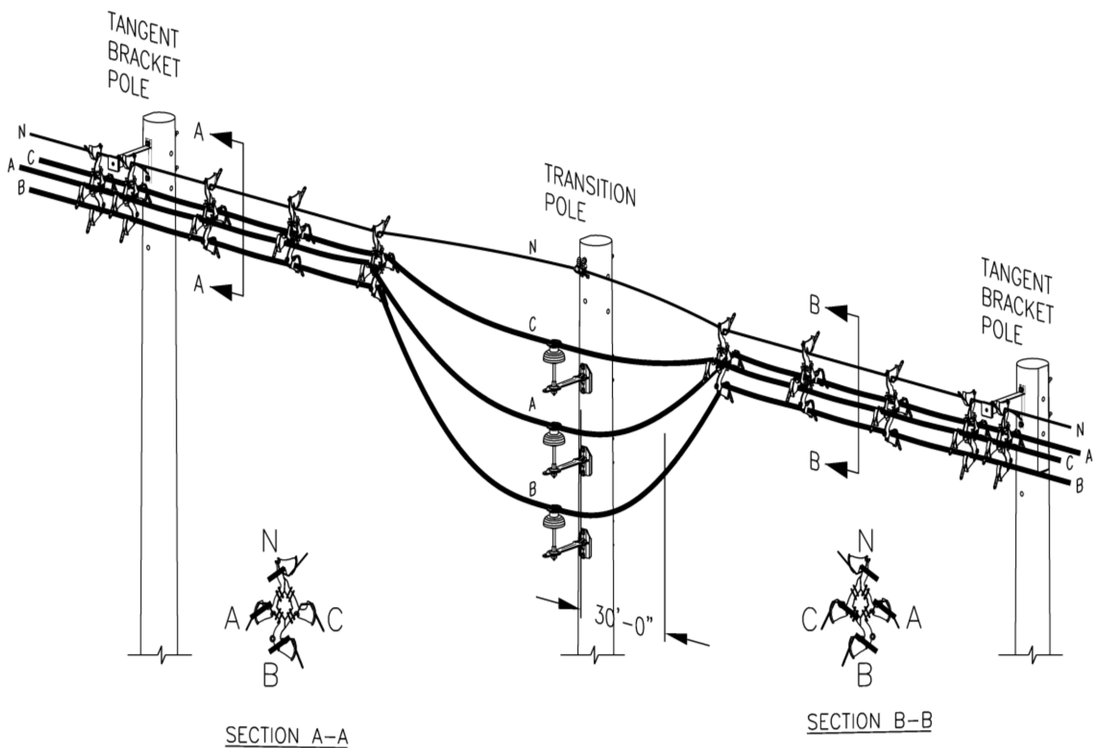
Designer	Drawing	Date
MPR	od16127	1/15/21

Supersedes 7/20 Issue - Updated 3D drawing.

APPLICATION – Use when field conditions do not readily allow for incoming and outgoing spacer cable systems to phase. Phase identification by pole stenciling of incoming and outgoing systems is recommended. The typical phasing diagram is shown below. Construction details of Transition Pole are shown on the Page 16-131.



TYPICAL PHASING DIAGRAM



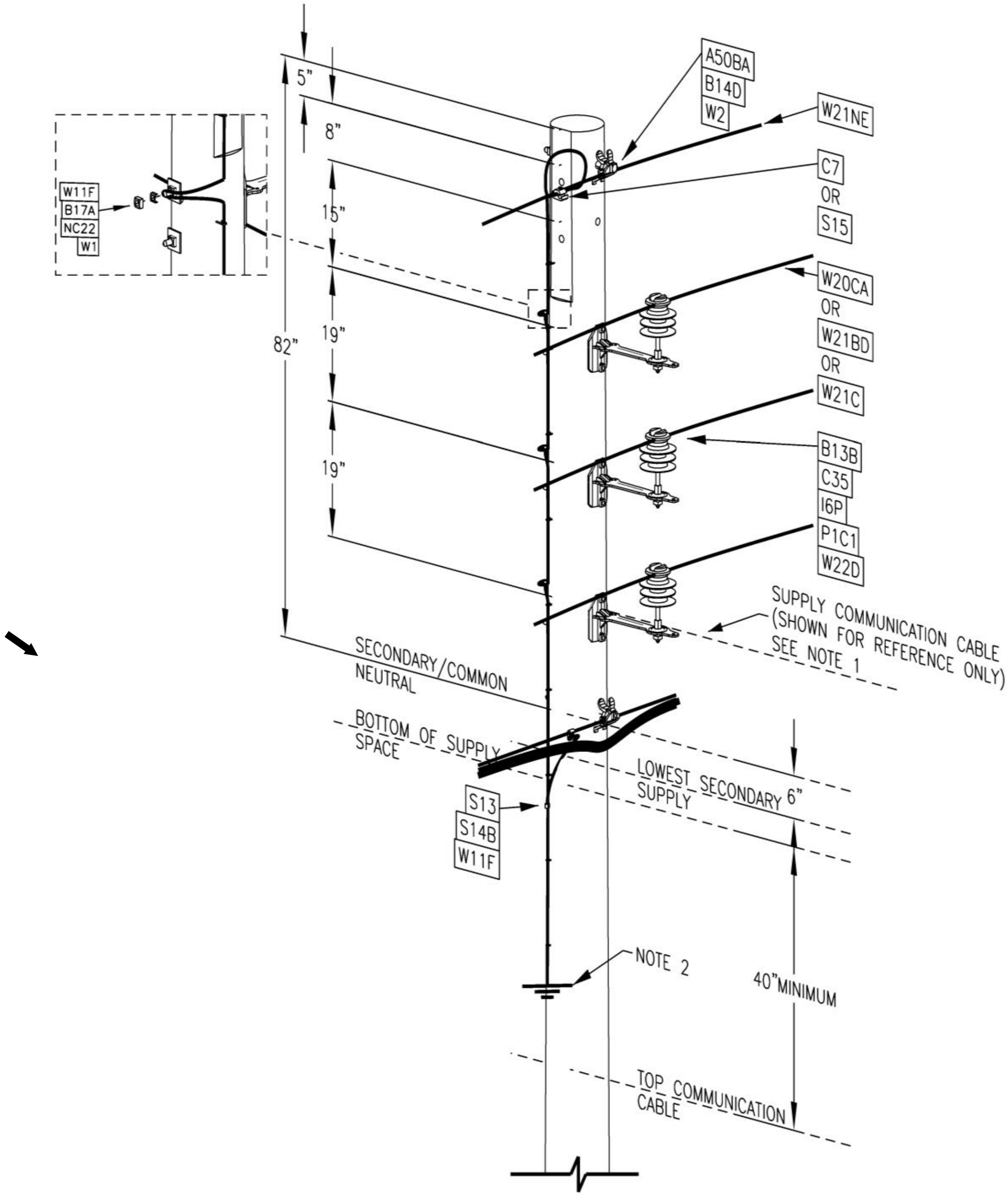
GENERAL ARRANGEMENT

NOTES:

1. USE THIS ARRANGEMENT WHEN FIELD CONDITIONS DO NOT READILY ALLOW FOR INCOMING AND OUTGOING SPACER CABLE SYSTEMS TO PHASE. PHASE IDENTIFICATION BY POLE STENCILING OF INCOMING AND OUTGOING SYSTEMS IS RECOMMENDED. THE TYPICAL PHASING DIAGRAM IS SHOWN BELOW. CONSTRUCTION DETAILS OF TRANSITION POLE ARE SHOWN ON THE PAGE 16-131.

Designer	Drawing	Date
MPR	od16130	6/30/20

MU = @16-131C(Y) | 0-15 kV (Y) = Wire Size



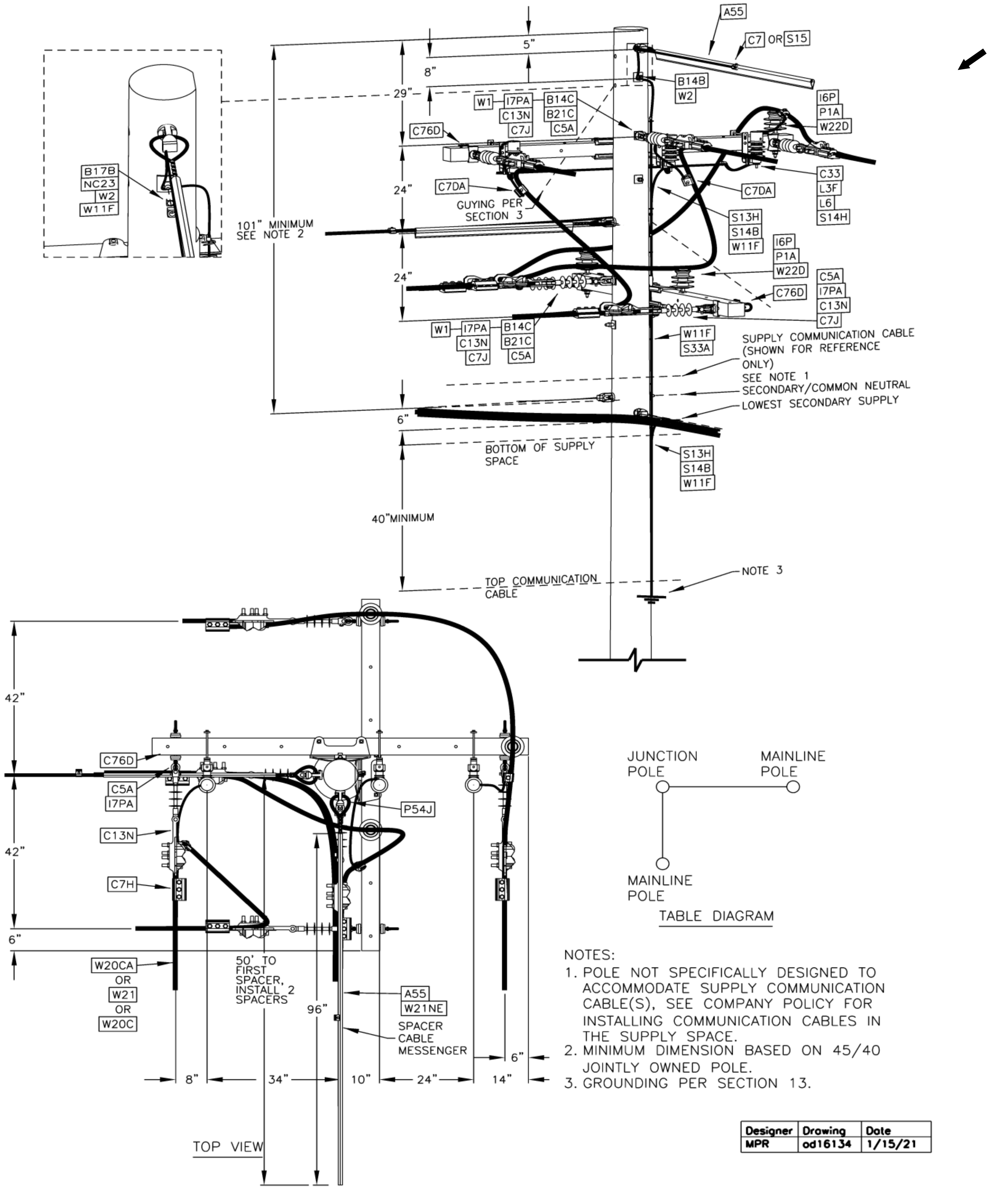
NOTES:

1. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY "POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE".
2. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16131	6/30/20

Supersedes 7/15 Issue – Updated 3D drawing

MU = @16-134C(Y)	0-15 kV (Y) = Wire Size



NOTES:

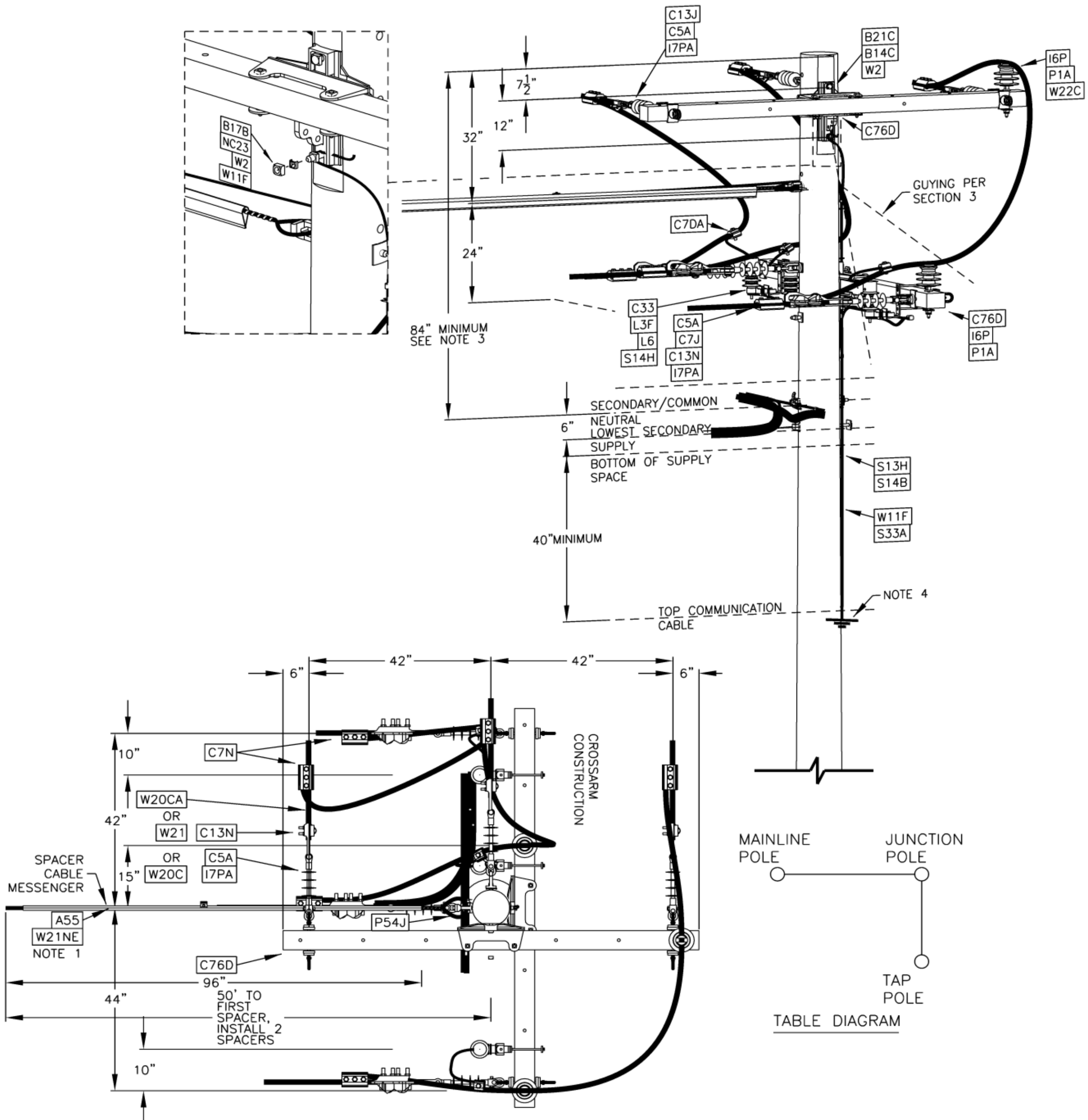
1. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S), SEE COMPANY POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE.
2. MINIMUM DIMENSION BASED ON 45/40 JOINTLY OWNED POLE.
3. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16134	1/15/21

Supersedes 7/20 Issue - Updated 3D drawing.

15KV JUNCTION POLE – TWO WAY BUCKARM SPACER CABLE DE TO SPACER CABLE DE – LINE ANGLES 61° - 120°			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 16-134	ISSUE 7/21

MU = @16-135C(Y)	0-15 kV (Y) = Wire Size



NOTES:

1. DRAWING AND MATERIAL LIST DEPICTS USE OF 477 BARE ALUMINUM CONDUCTOR.
2. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S), SEE COMPANY POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE.
3. MINIMUM DIMENSION BASED ON 45/40 JOINTLY OWNED POLE.
4. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16135	1/15/21

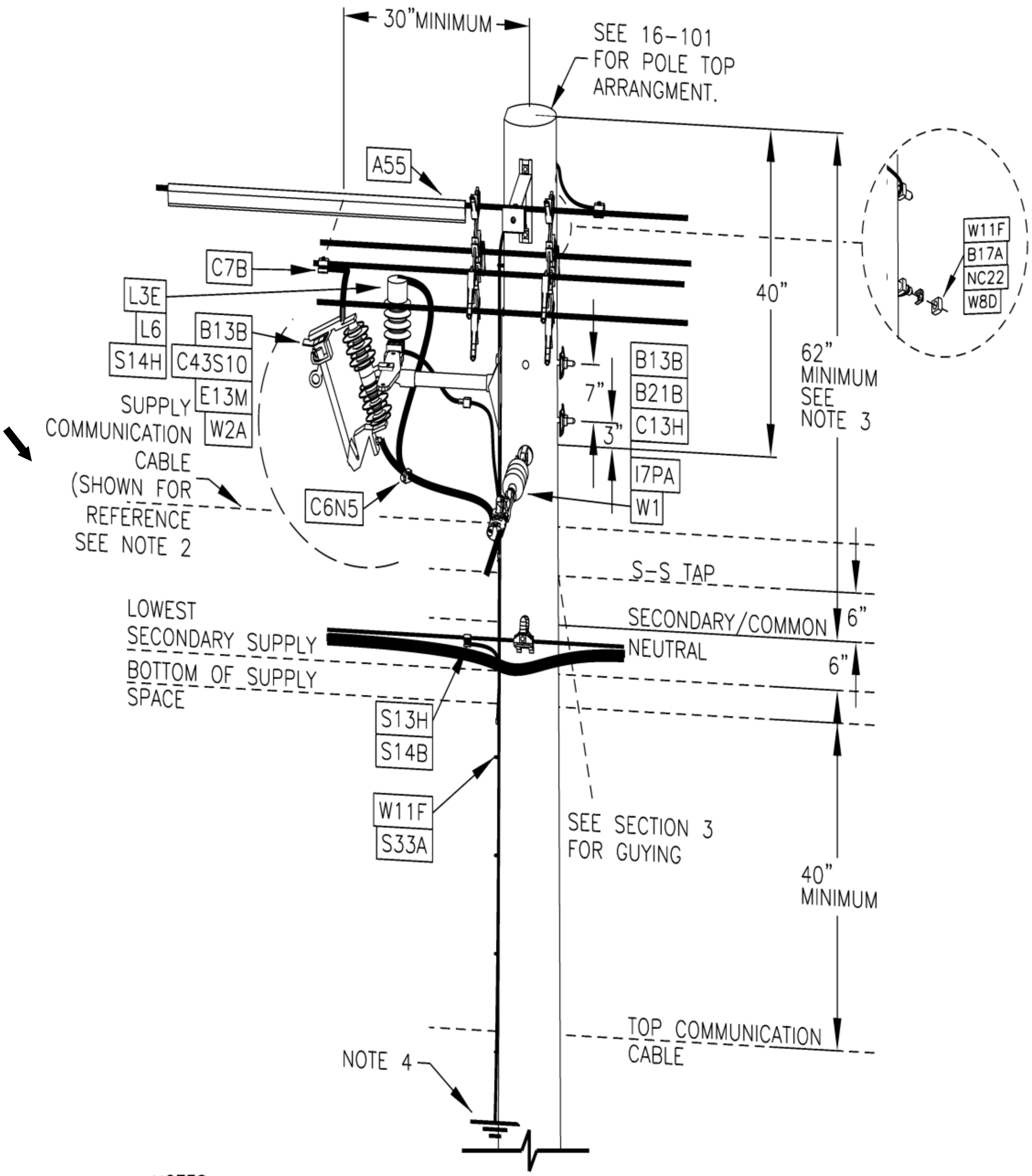
Supersedes 7/20 Issue - Updated 3D drawing

15KV JUNCTION POLE – TWO WAY – CROSSARM MAINLINE DE TO SPACER CABLE TAP DE – LINE ANGLES 61° - 90°

ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/21	16-135		

MU = @16-138W1/0TC(Y) | 0-15 kV (Y) = Wire Size

Supersedes 7/15 Issue – Updated 3D drawing



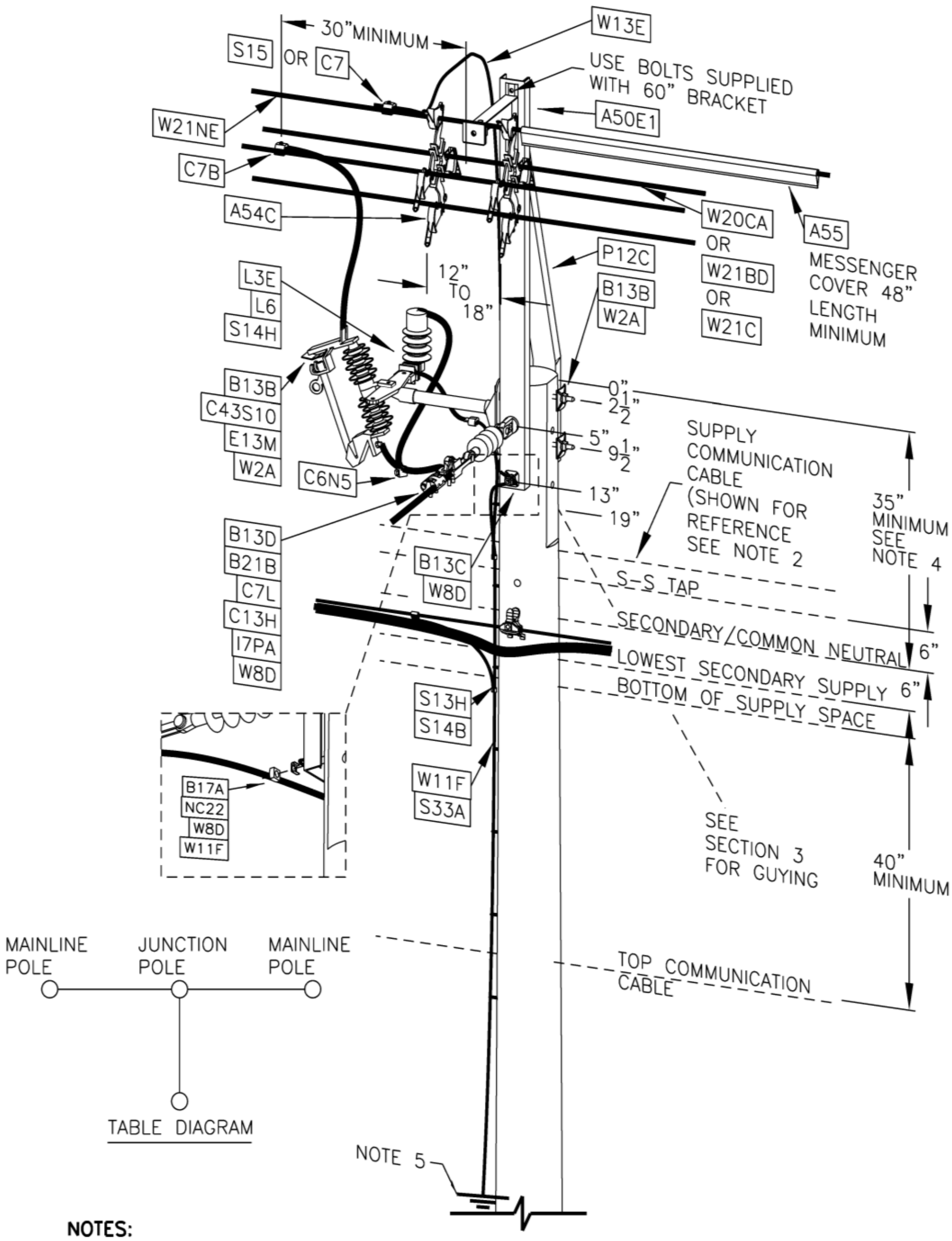
NOTES:

1. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8' CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12", 35KV).
2. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE.
3. MINIMUM DIMENSION BASED ON A 40/40 JOINTLY OWNED POLE.
4. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16138	6/30/20

15KV JUNCTION POLE THREE WAY 14" TANGENT BRACKET TO SINGLE PHASE TAP			
	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		16-138	7/20

MU = @16-139W1/0TC(Y) | 0-15 kV (Y) = Wire Size



Supersedes 7/15 Issue – Updated 3D drawing

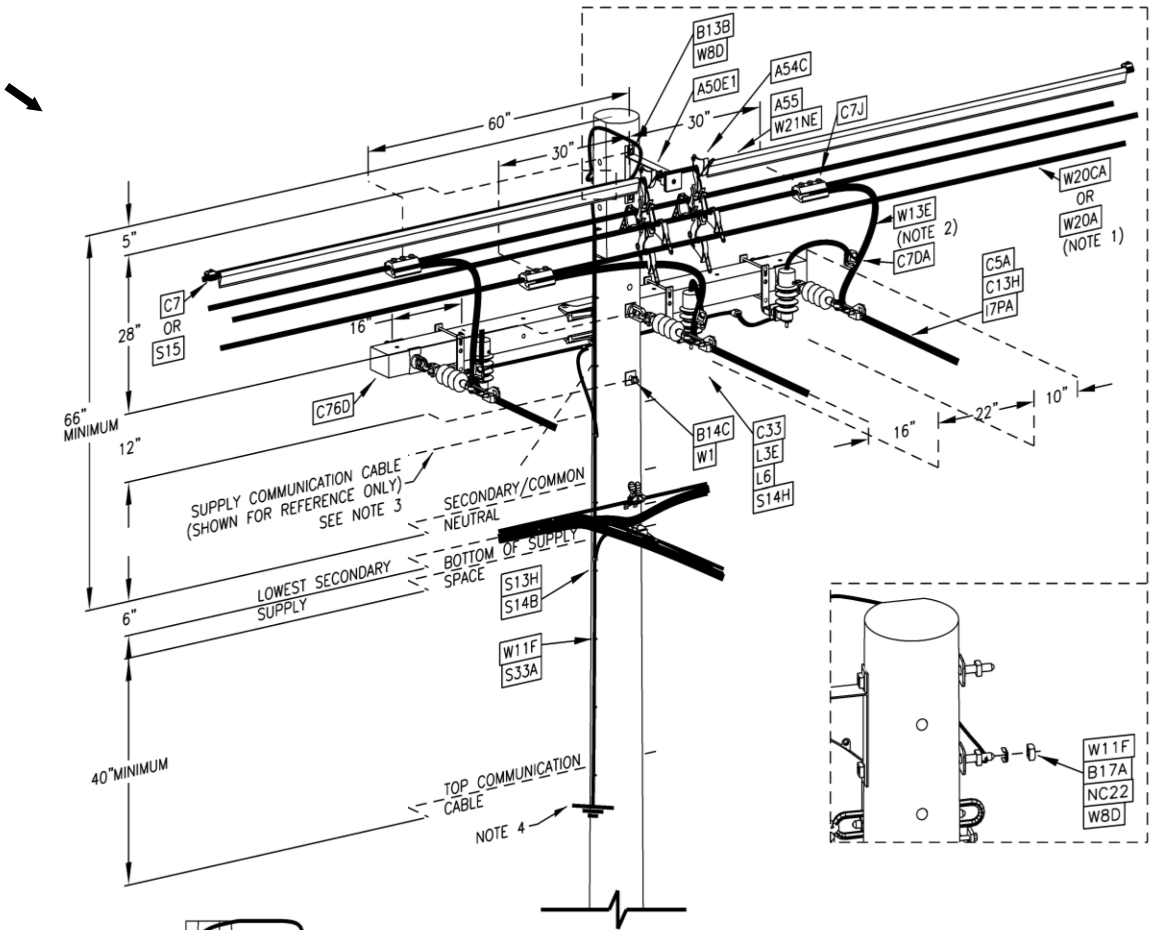
NOTES:

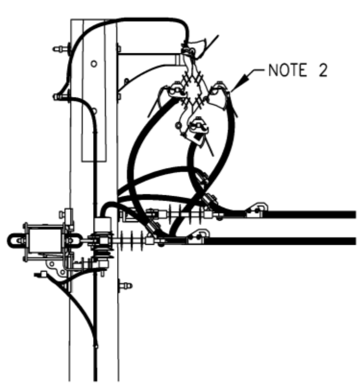
1. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
2. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY "POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE."
3. EXISTING 35' POLE - OLD AGREEMENTS AND SETTING DEPTH.
4. MINIMUM DIMENSION BASED ON A 40/40 JOINTLY OWNED POLE.
5. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16139	6/30/20

MU = @16-142C(Y)	0-15 kV (Y) = Wire Size
MU = @16-1422PHC(Y)	0-15 kV 2 Ph. Jct., (Y) = Wire Size

Supersedes 7/15 Issue – Updated 3D drawing





TAP DETAIL

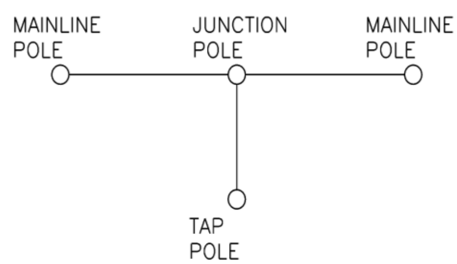
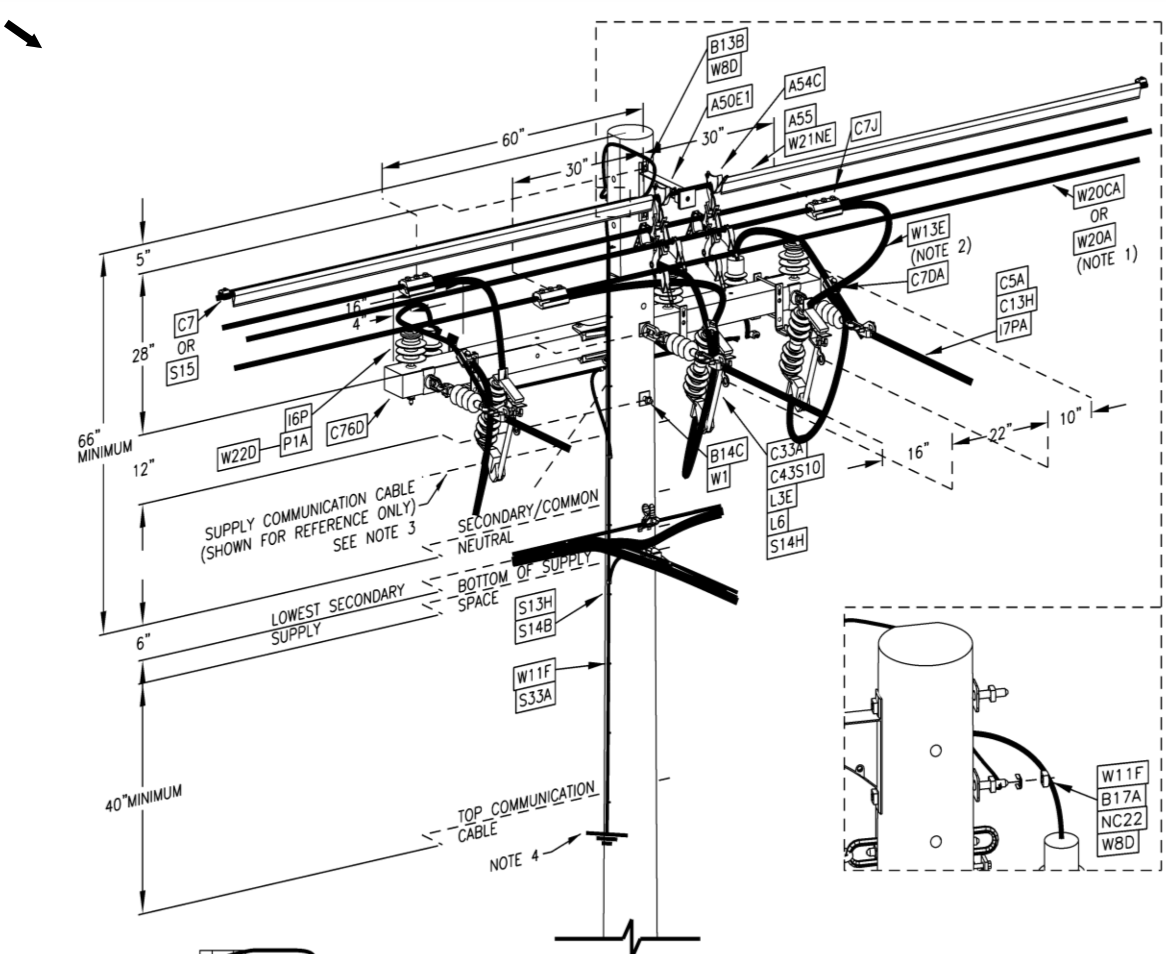


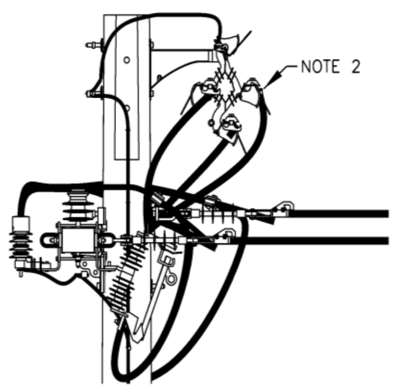
TABLE DIAGRAM

NOTES:
1. DRAWING AND MATERIAL LIST DEPICTS USE OF 477 BARE ALUMINUM CONDUCTOR.
2. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
3. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY "POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE."
4. GROUND PER SECTION 13.

Designer	Drawing	Date
MPR	od16142	6/30/20

15KV JUNCTION POLE – THREE WAY – SPACER CABLE MAINLINE WITH TANGENT BRACKET TO CROSSARM CONSTRUCTION (UNFUSED)			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 16-142	ISSUE 7/20





TAP DETAIL

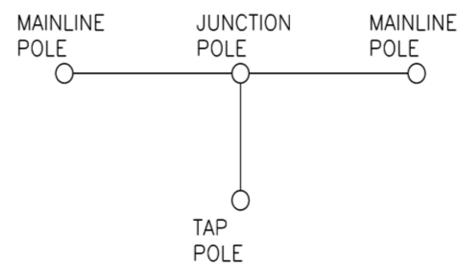


TABLE DIAGRAM

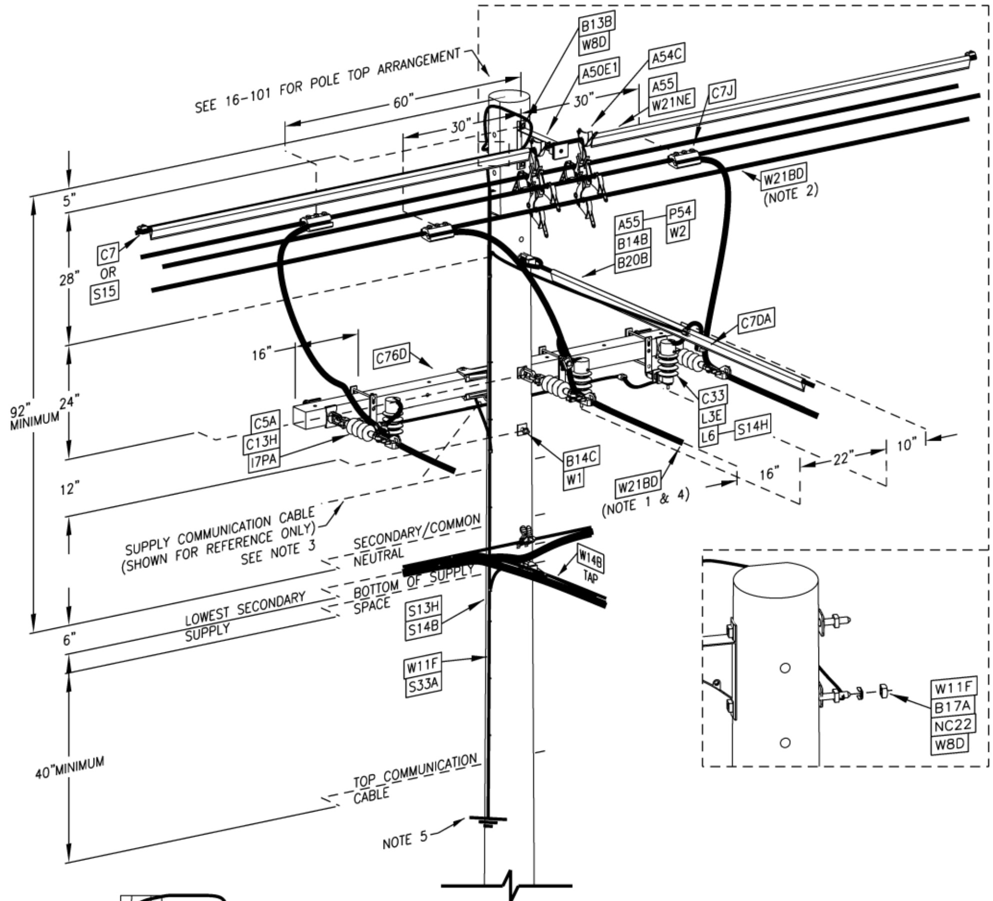
Supersedes 7/15 Issue – Updated 3D drawing

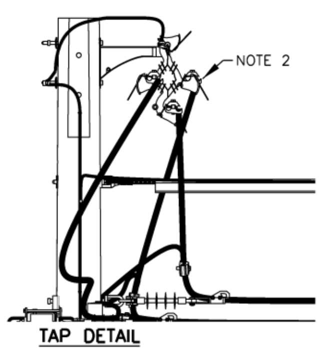
NOTES:
1. DRAWING AND MATERIAL LIST DEPICTS USE OF 1/0 (6201) BARE AZUZA OR TREE WIRE.
2. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
3. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY "POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE."
4. GROUNDING PER SECTION 13.

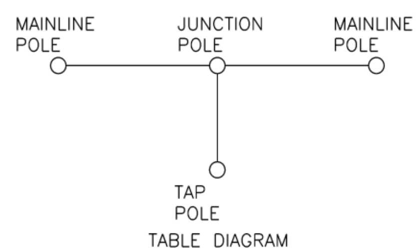
Designer	Drawing	Date
MPR	od16143	6/30/20

MU = @16-146C(Y) | 0-15 kV (Y) = Wire Size

Supersedes 7/20 Issue – Updated 3D drawing



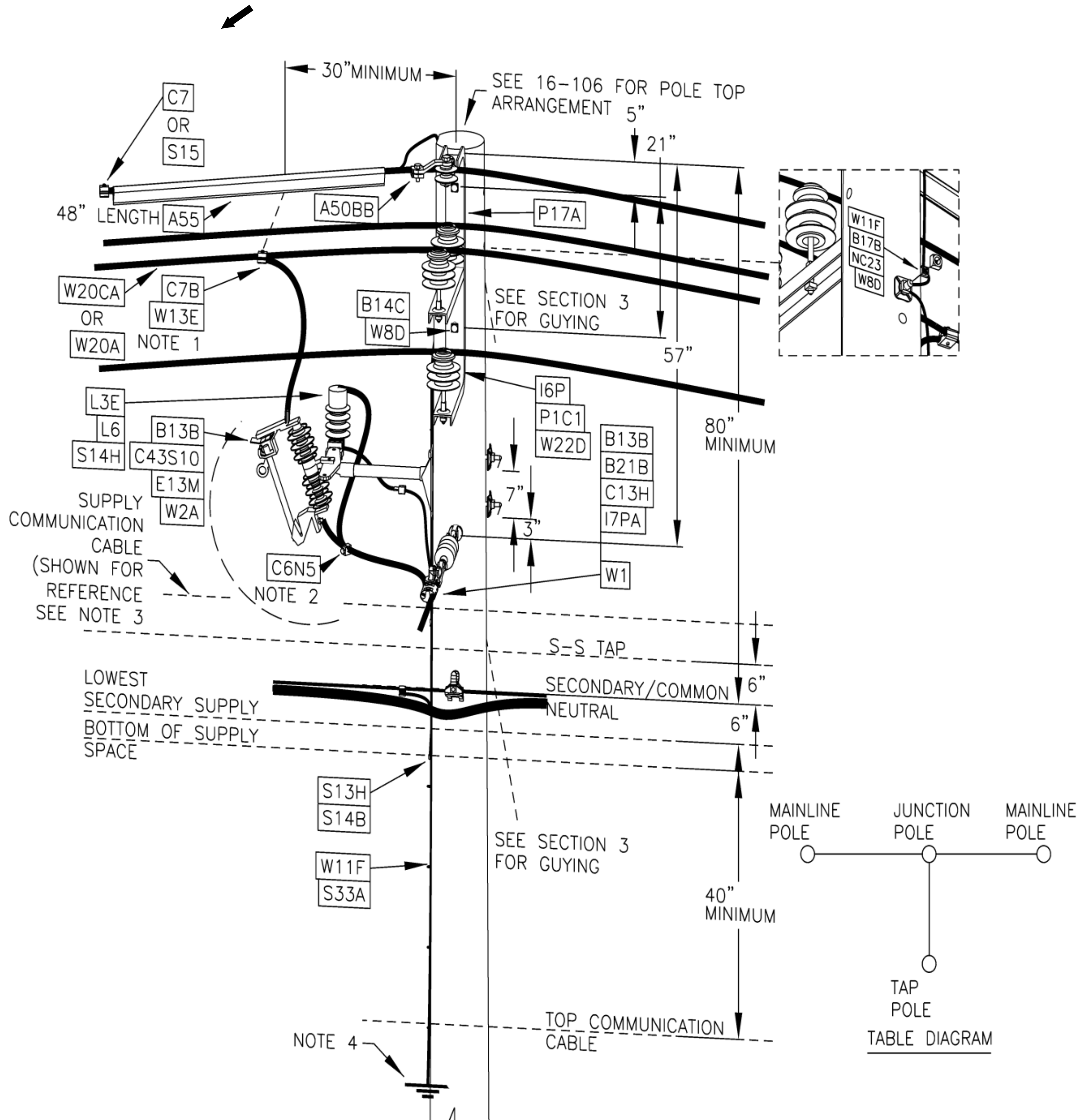




NOTES:
1. DRAWING AND MATERIAL LIST DEPICTS USE OF 477 SPACER CABLE.
2. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
3. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY "POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE."
4. FIRST SPACER LOCATION – 50' FROM CROSSARM. INSTALL 2 SPACERS.
5. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16146	1/15/21

MU = @16-148CW1/0TC(Y)	0-15 kV (Y) = Wire Size



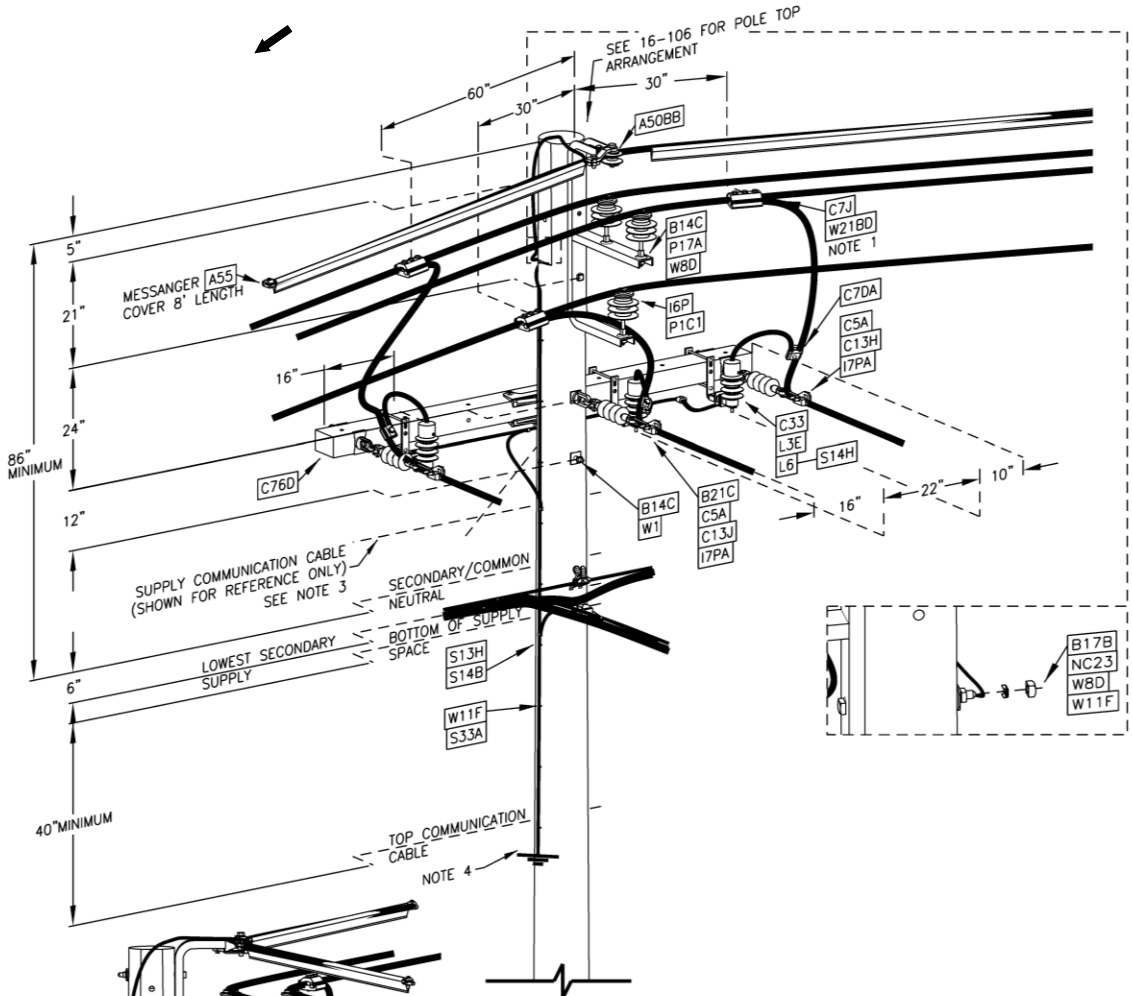
NOTES:

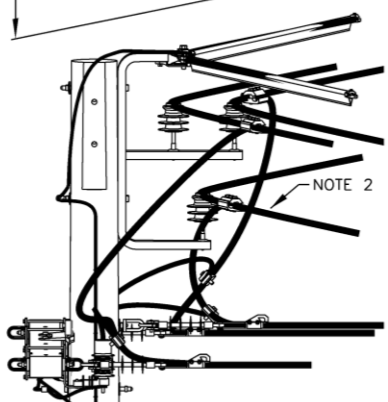
1. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8' CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12", 35KV).
2. TRAIN UNDER BRACKET BODY AND CONNECT TO POLE DOWN-GROUND.
3. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE.
4. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16148	6/30/20

Supersedes 7/15 Issue – Updated drawing to 3D

MU = @16-150C(Y)	0-15 kV (Y) = Wire Size
MU = @16-1502PHC(Y)	0-15 kV 2PH Jct., (Y) = Wire Size





TAP DETAIL

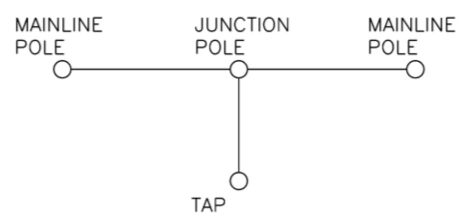


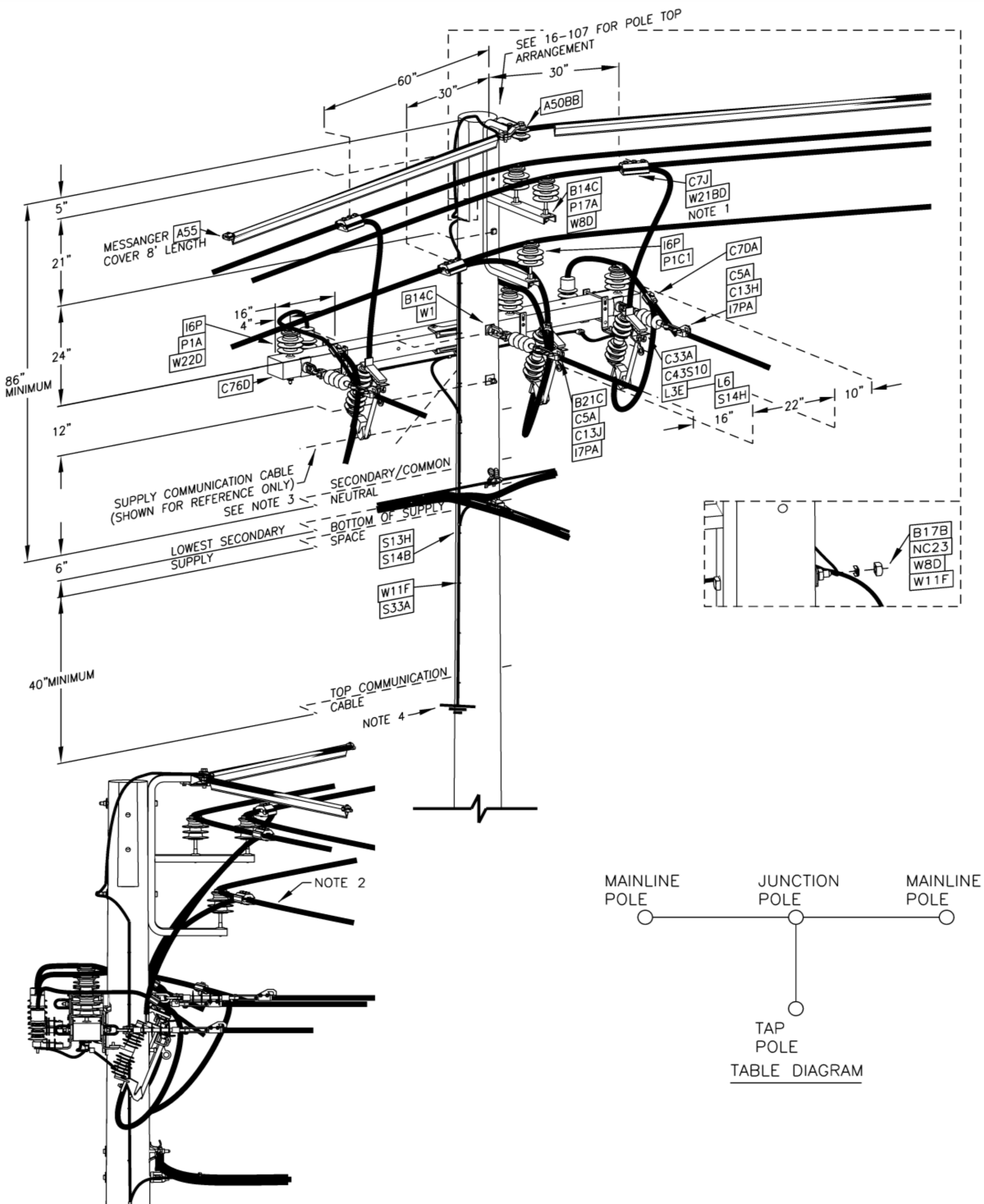
TABLE DIAGRAM

Supersedes 7/15 Issue – Updated drawing to 3D

NOTES:

1. DRAWING AND MATERIAL LIST DEPICTS USE OF 477 BARE ALUMINUM CONDUCTOR.
2. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
3. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY "POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE."
4. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16150	6/30/20



TAP DETAIL

TABLE DIAGRAM

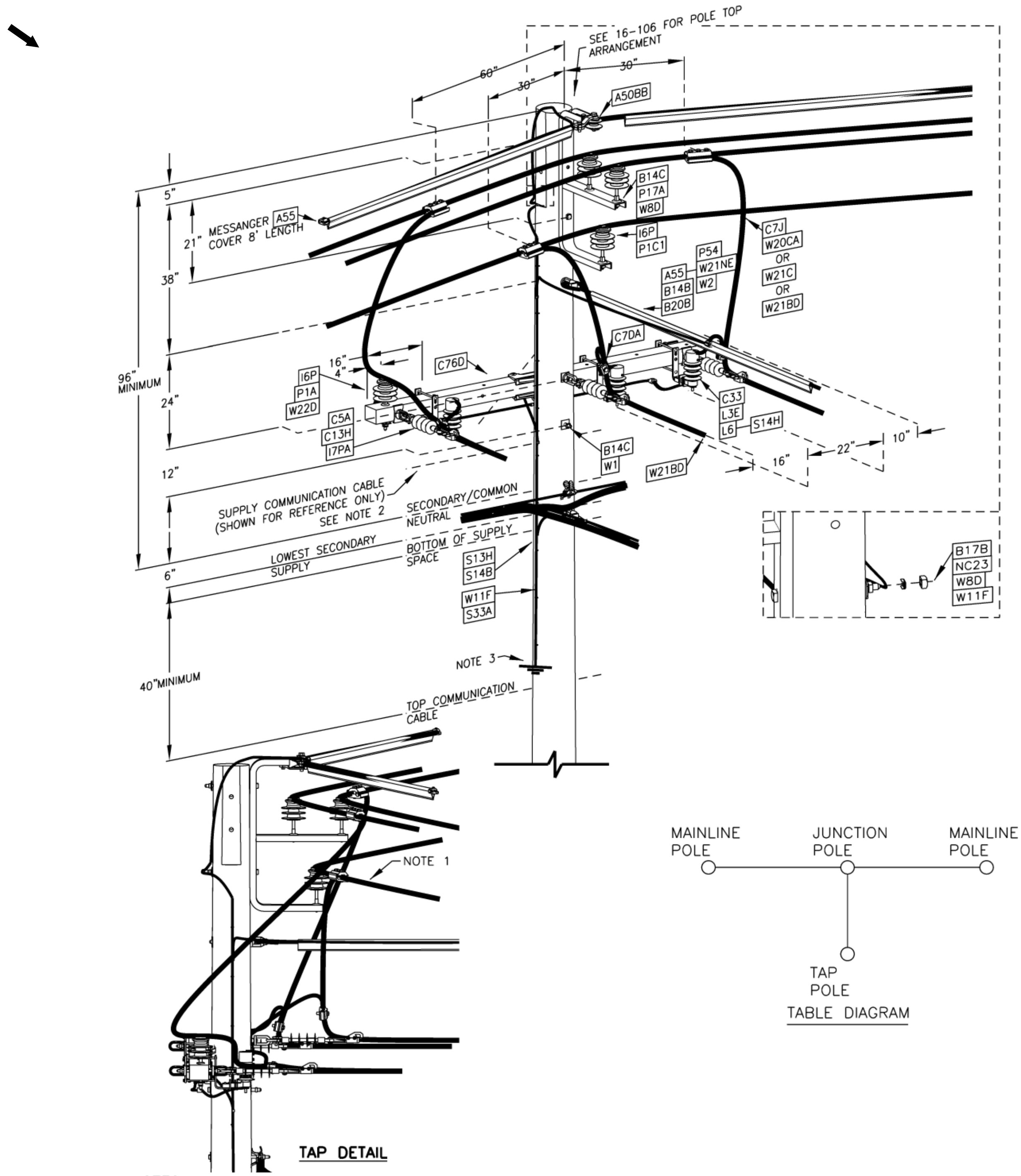
NOTES:

1. DRAWING AND MATERIAL LIST DEPICTS USE OF 1/0 (6201) BARE AZUZA OR TREE WIRE ON TAP LINE.
2. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
3. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY "POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE."
4. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16151	6/30/20

Supersedes 7/15 Issue – Updated drawing to 3D

Supersedes 7/20 Issue – Updated drawing to 3D



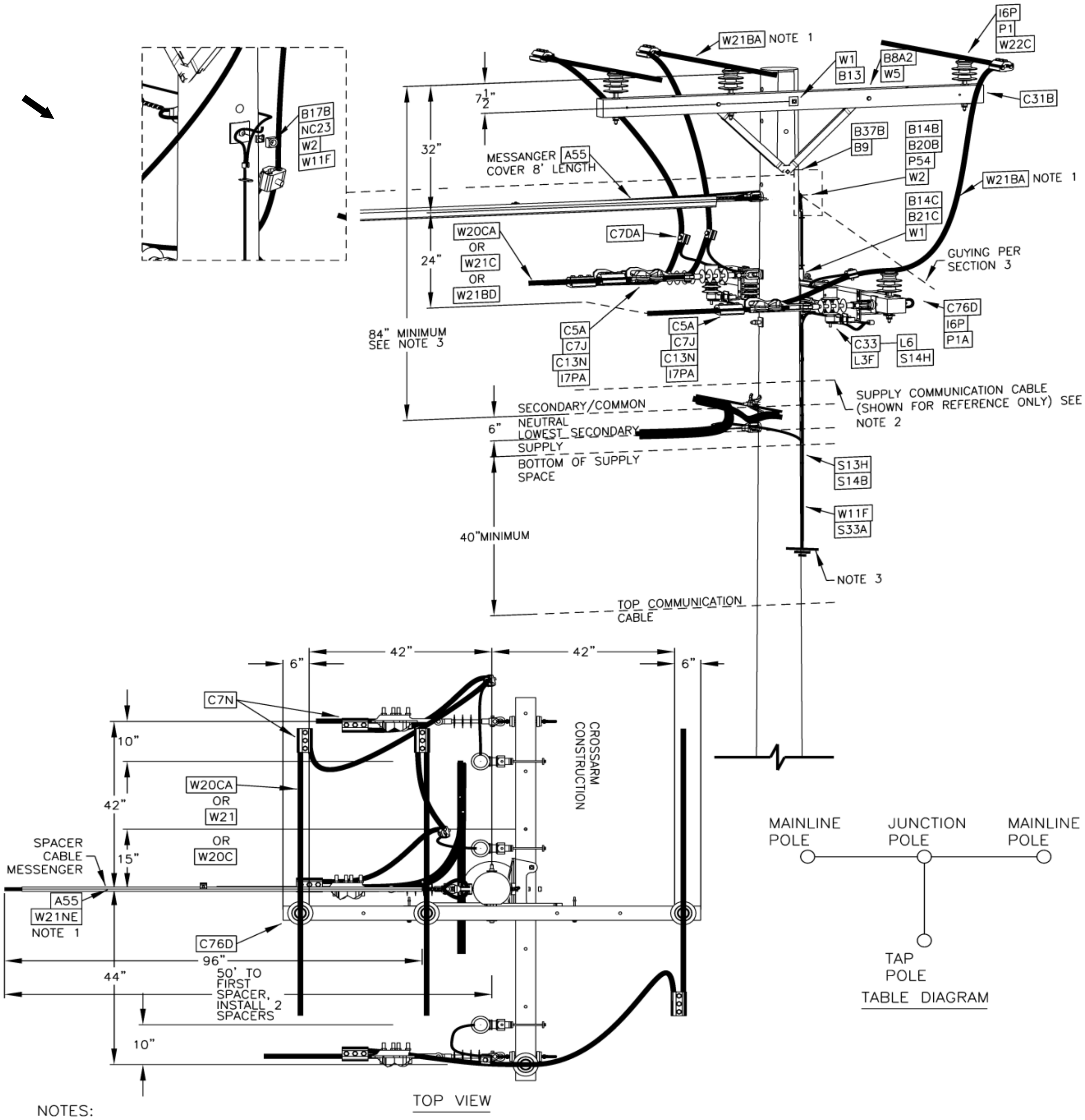
NOTES:

1. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
2. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S). SEE COMPANY "POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE."
3. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16153	1/15/21

15KV JUNCTION POLE – THREE WAY – SPACER CABLE E –BRACKET MAINLINE TO SPACER CABLE TAP (UNFUSED)

MU = @16-155C(Y)	0-15 kV 0º to 10º, (Y) = Wire Size
MU = @16-15511C(Y)	0-15 kV 11º to 20º, (Y) = Wire Size
MU = @16-15521C(Y)	0-15 kV 21º to 45º, (Y) = Wire Size
MU = @16-15546C(Y)	0-15 kV 46º to 60º, (Y) = Wire Size



NOTES:

1. DRAWING AND MATERIAL LIST DEPICTS USE OF 477 BARE ALUMINUM CONDUCTOR.
2. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S), SEE COMPANY POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE.
3. GROUNDING PER SECTION 13.

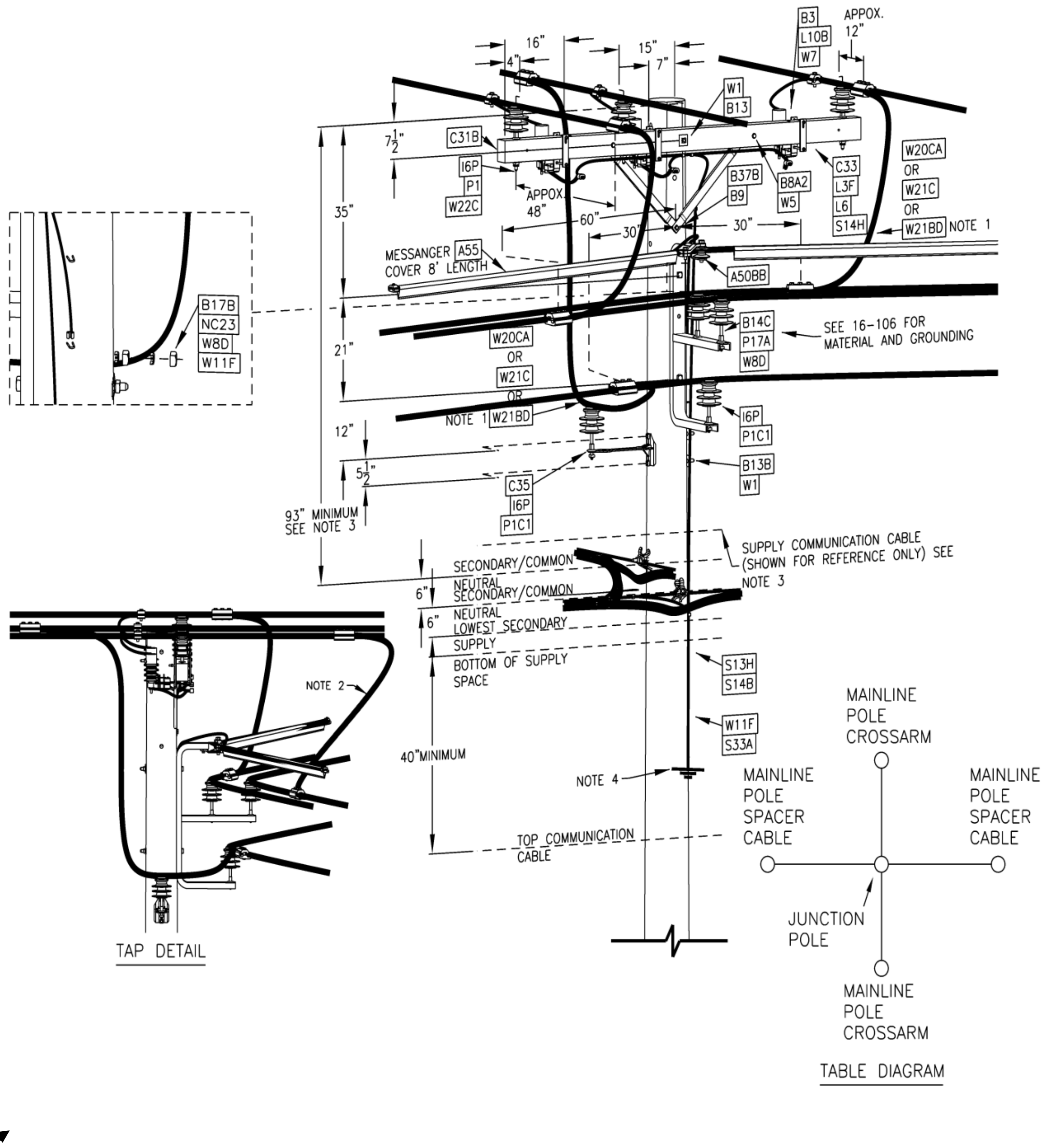
Designer	Drawing	Date
MPR	od16155	1/15/21

Supersedes 7/20 Issue - Updated drawing to 3D

15KV JUNCTION POLE – THREE WAY – THREE PHASE CROSSARM MAINLINE TO SPACER CABLE TAP

ISSUE	PAGE NUMBER		
7/21	16-155	OVERHEAD CONSTRUCTION STANDARD	ppl

Supersedes 7/15 Issue – Updated drawing to 3D



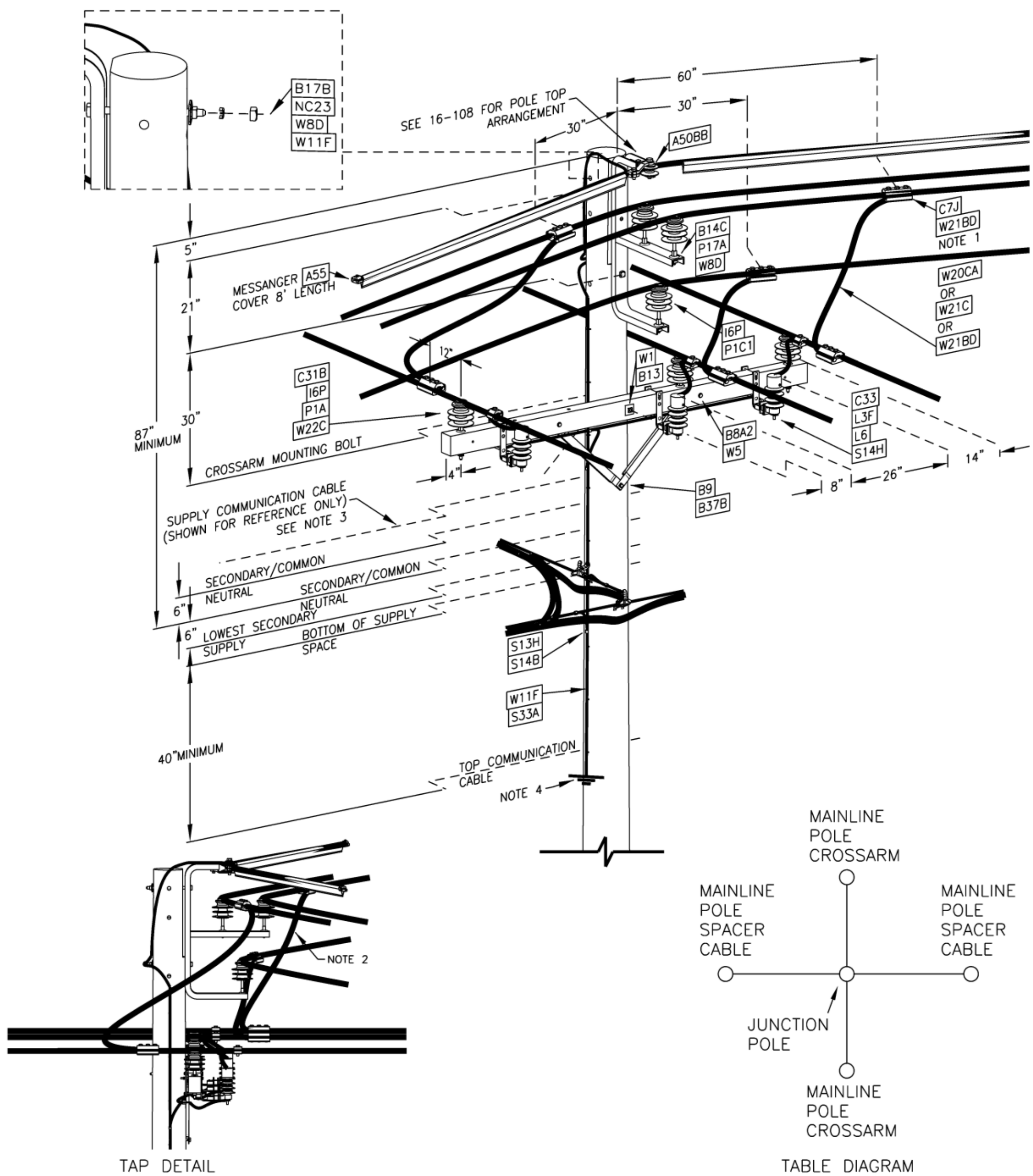
NOTES:

1. **DRAWING AND MATERIAL LIST DEPICTS USE OF 477 BARE ALUMINUM CONDUCTOR.**
2. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
3. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S), SEE COMPANY POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE.
4. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16157	6/30/20

15KV JUNCTION POLE – FOUR WAY – CROSSARM CONSTRUCTION MAINLINE TO SPACER CABLE MAINLINE			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 16-157	ISSUE 7/20

MU = @16-158C(Y)	0-15 kV (Y) = Wire Size

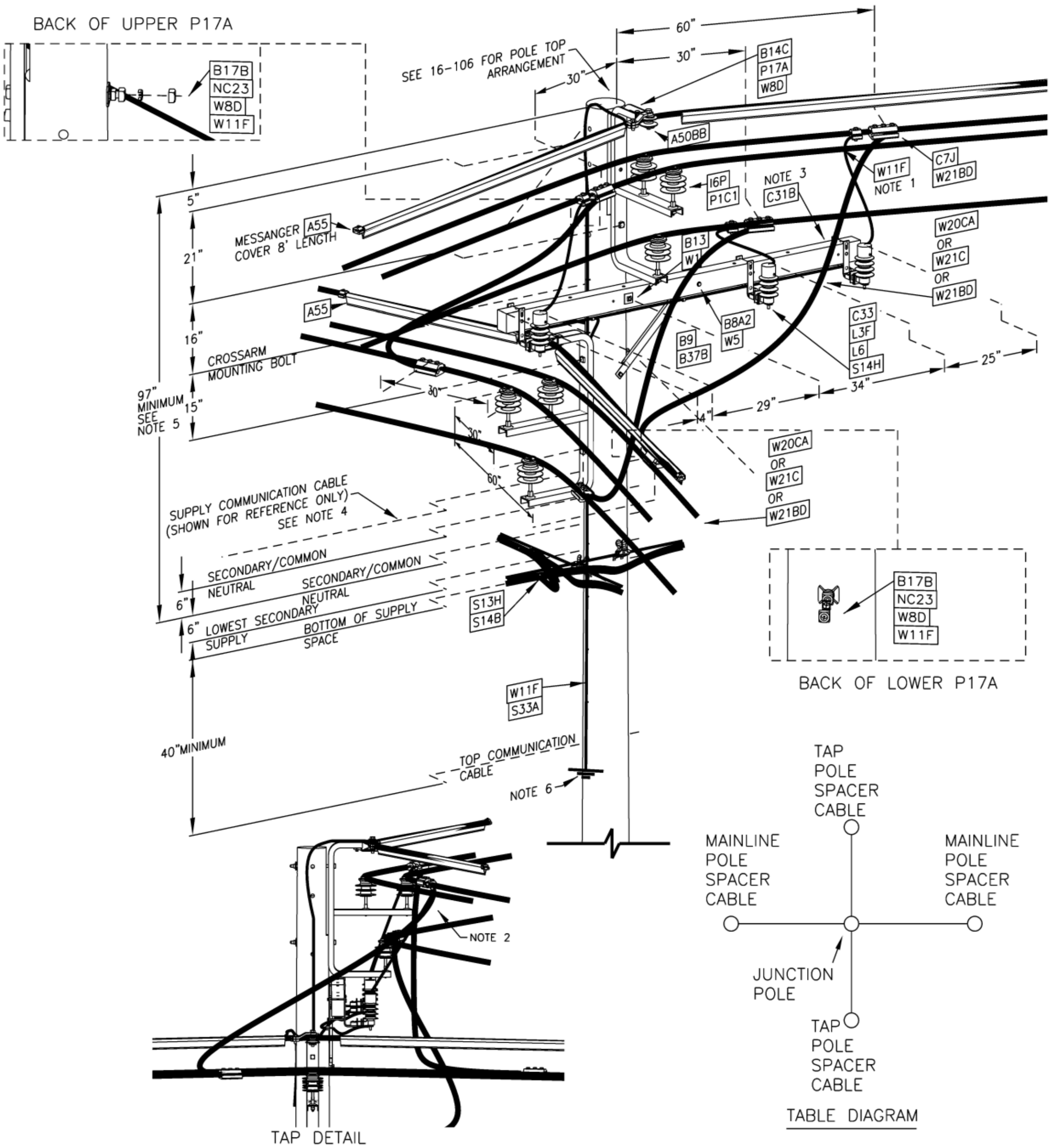


NOTES:

1. **DRAWING AND MATERIAL LIST DEPICTS USE OF 477 BARE ALUMINUM CONDUCTOR.**
2. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
3. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S), SEE COMPANY POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE.
4. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16158	6/30/20

Supersedes 7/15 Issue – Updated drawing to 3D



NOTES:

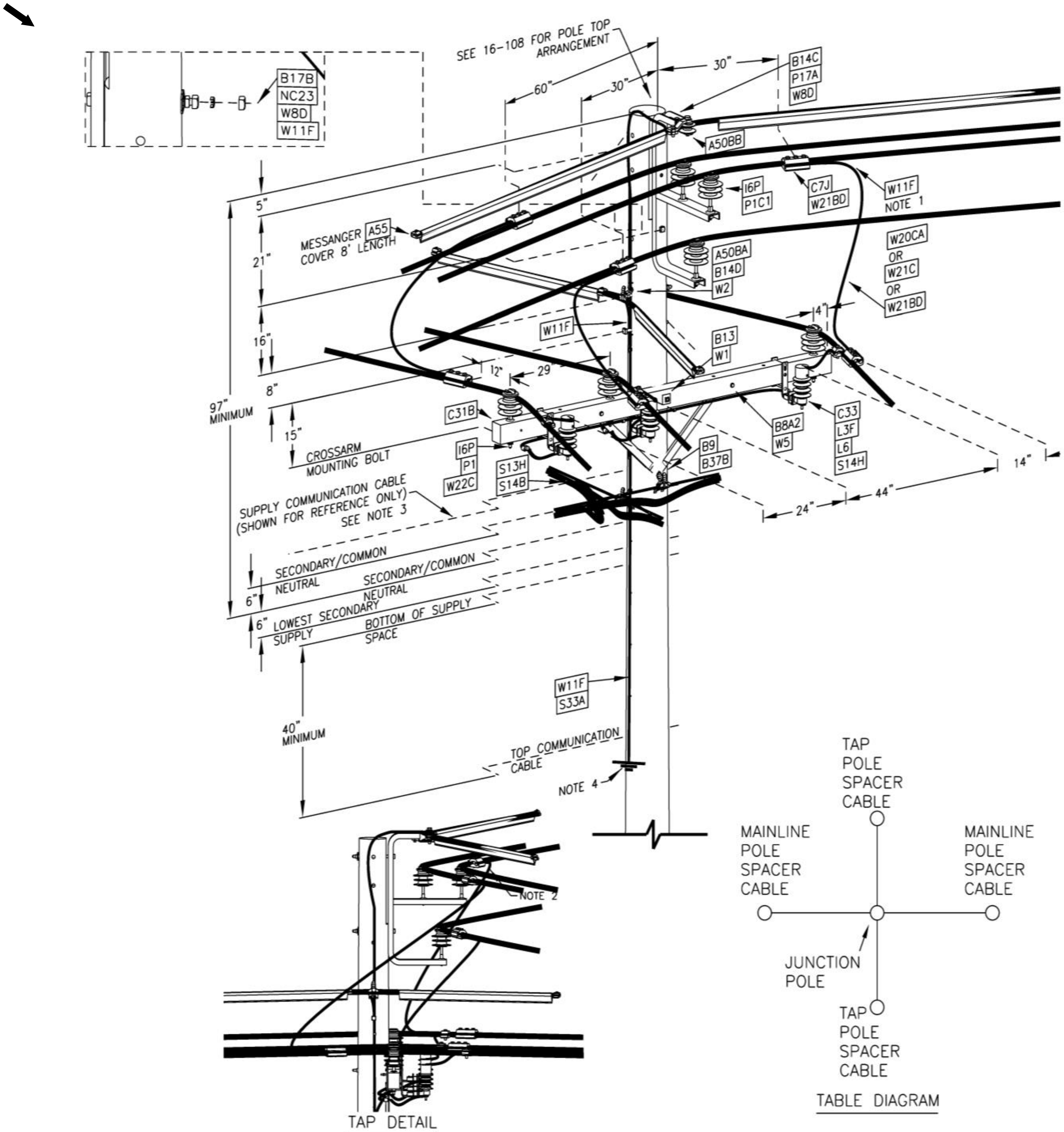
1. **USE #4 AWG. COVERED COPPER WIRE FOR ARRESTER PRIMARY TAP LEADS (W11F).**
2. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
3. CROSSARM IS "SEMI-OUTRIGGED" FOR CLEARANCE OF PHASE TAPS.
4. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S), SEE COMPANY POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE.
5. MINIMUM DIMENSION BASED ON A 45/40 JOINT OWNED POLE.
6. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16160	6/30/20

Supersedes 7/15 Issue – Updated drawing to 3D

15KV JUNCTION POLE – FOUR WAY – SPACER CABLE E – BRACKET TO SPACER CABLE E – BRACKET (LINE ANGLES 7˚ – 30˚)

MU = @16-161C(Y)	0-15 kV (Y) = Wire Size



NOTES:

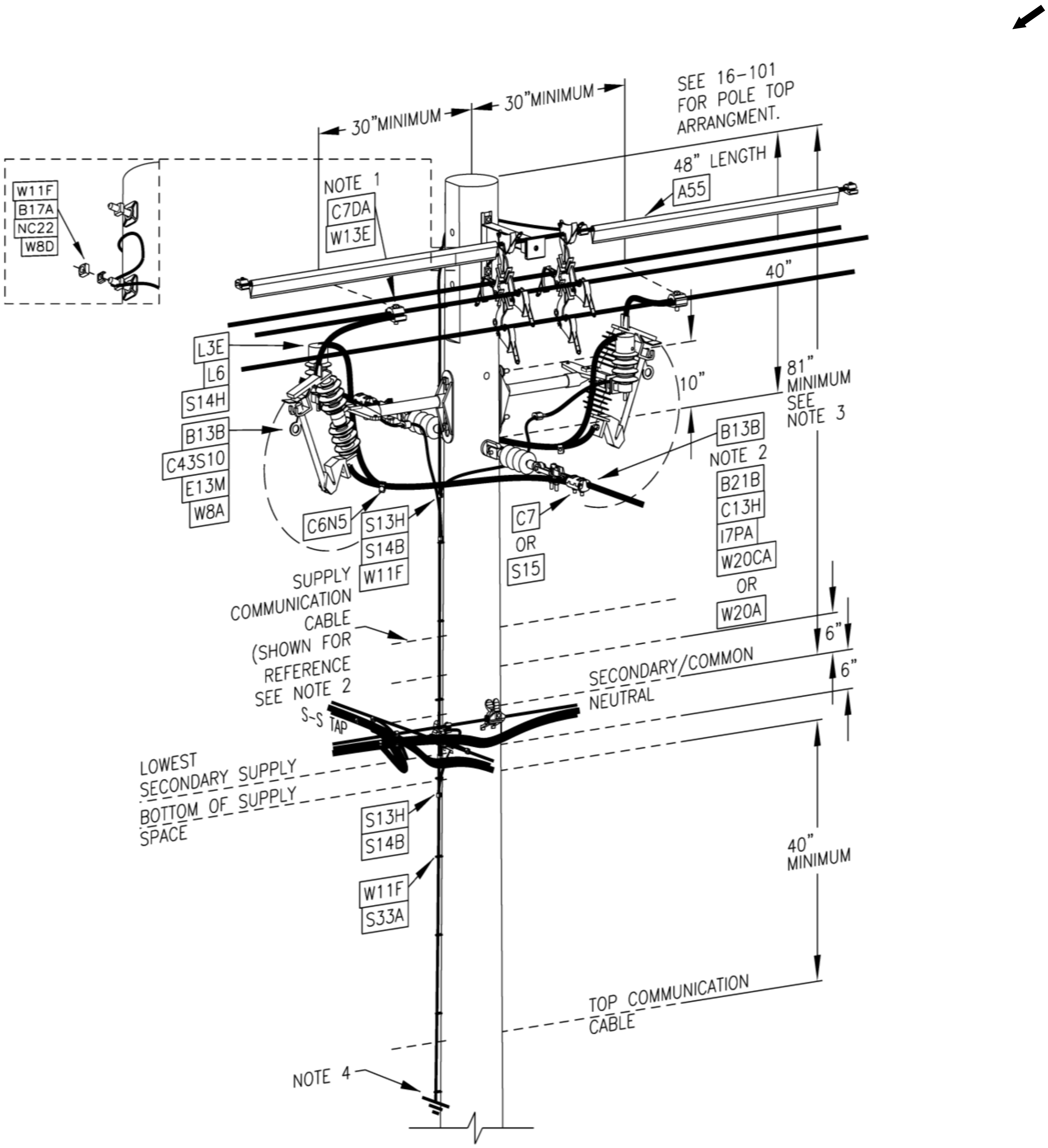
1. **DRAWING AND MATERIAL LIST DEPICTS USE OF 477 BARE ALUMINUM CONDUCTOR.**
2. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
3. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S), SEE COMPANY POLICY FOR INSTALLING COMMUNICATION CABLES IN THE SUPPLY SPACE.
4. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16161	6/30/20

Supersedes 7/15 Issue – Updated drawing to 3D

MU = @16-163C(Y)	0-15 kV (Y) = Wire Size

Supersedes 7/15 Issue – Updated drawing to 3D



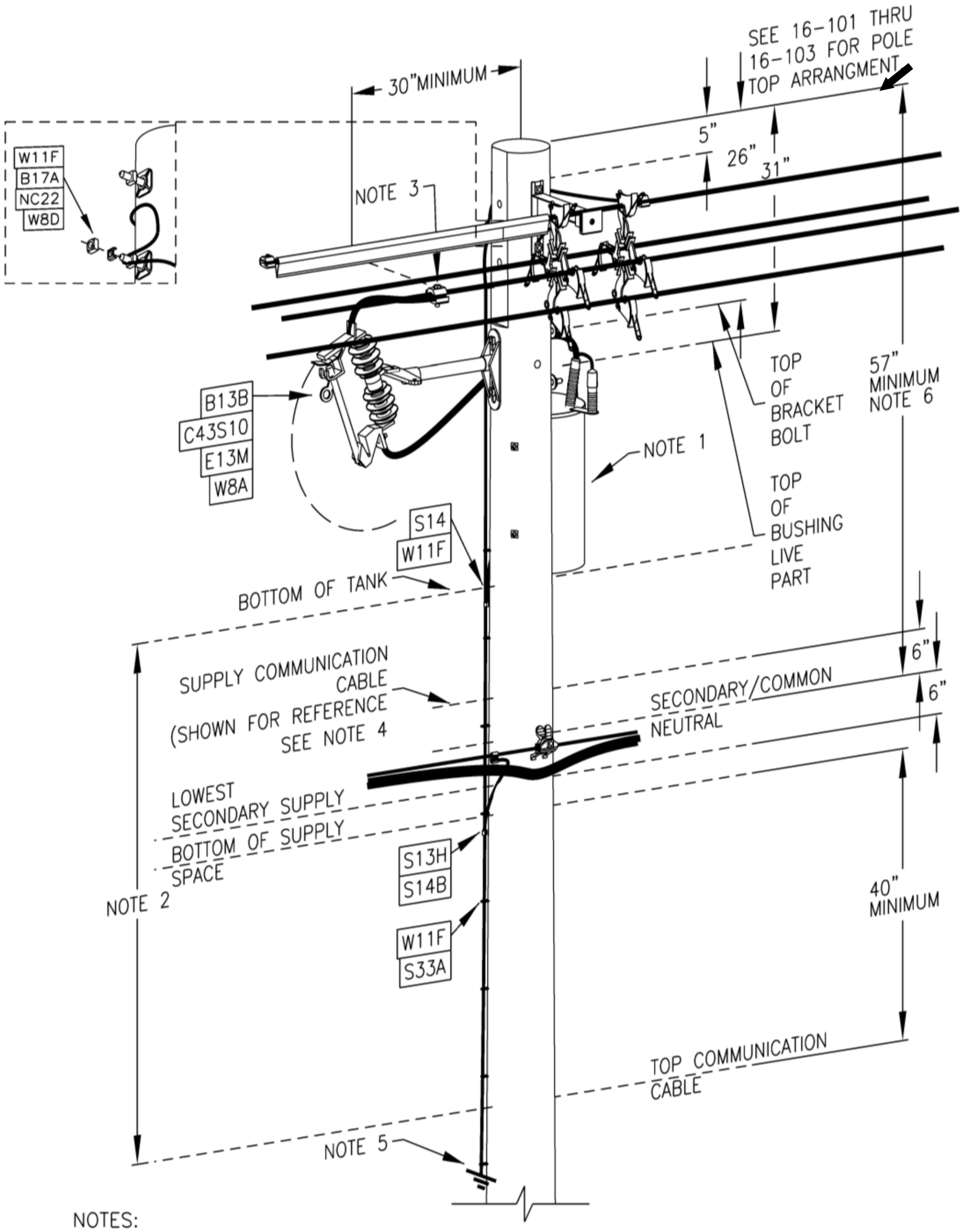
NOTES:

1. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
2. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S).
3. MINIMUM DIMENSION BASED ON 1/ø SPACER CABLE CONDUCTOR ON A 45/45 JOINTLY OWNED POLE.
4. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16163	6/30/20

15KV JUNCTION POLE – FOUR WAY – 14" OR 24" TANGENT BRACKET TO SINGLE PHASE TAPS

ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		16-163	7/20



NOTES:

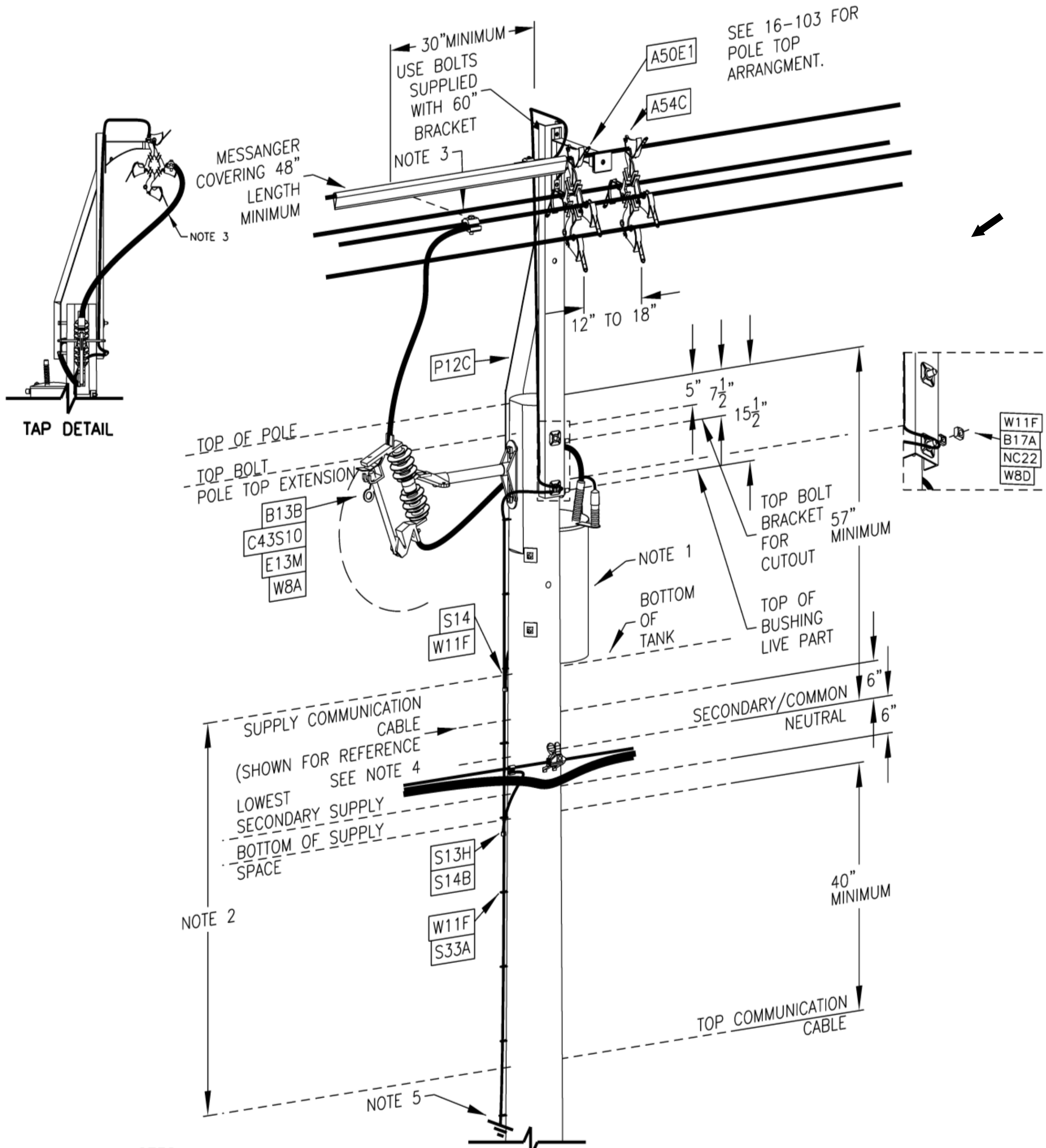
1. SECONDARY TRANSFORMER CONNECTIONS NOT SHOWN.
2. MAINTAIN 30" MINIMUM – BOTTOM TANK TO TOP COMMUNICATION.
3. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
4. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S).
5. GROUNDING PER SECTION 13.
6. MINIMUM DIMENSION SHOWN FOR 1/ø SPACER CABLE CONDUCTOR ON A 40/40 JOINTLY OWNED POLE.

Designer	Drawing	Date
MPR	od16165	6/30/20

Supersedes 7/15 Issue – Updated drawing to 3D

15KV LINE POLE – SINGLE PHASE TRANSFORMER

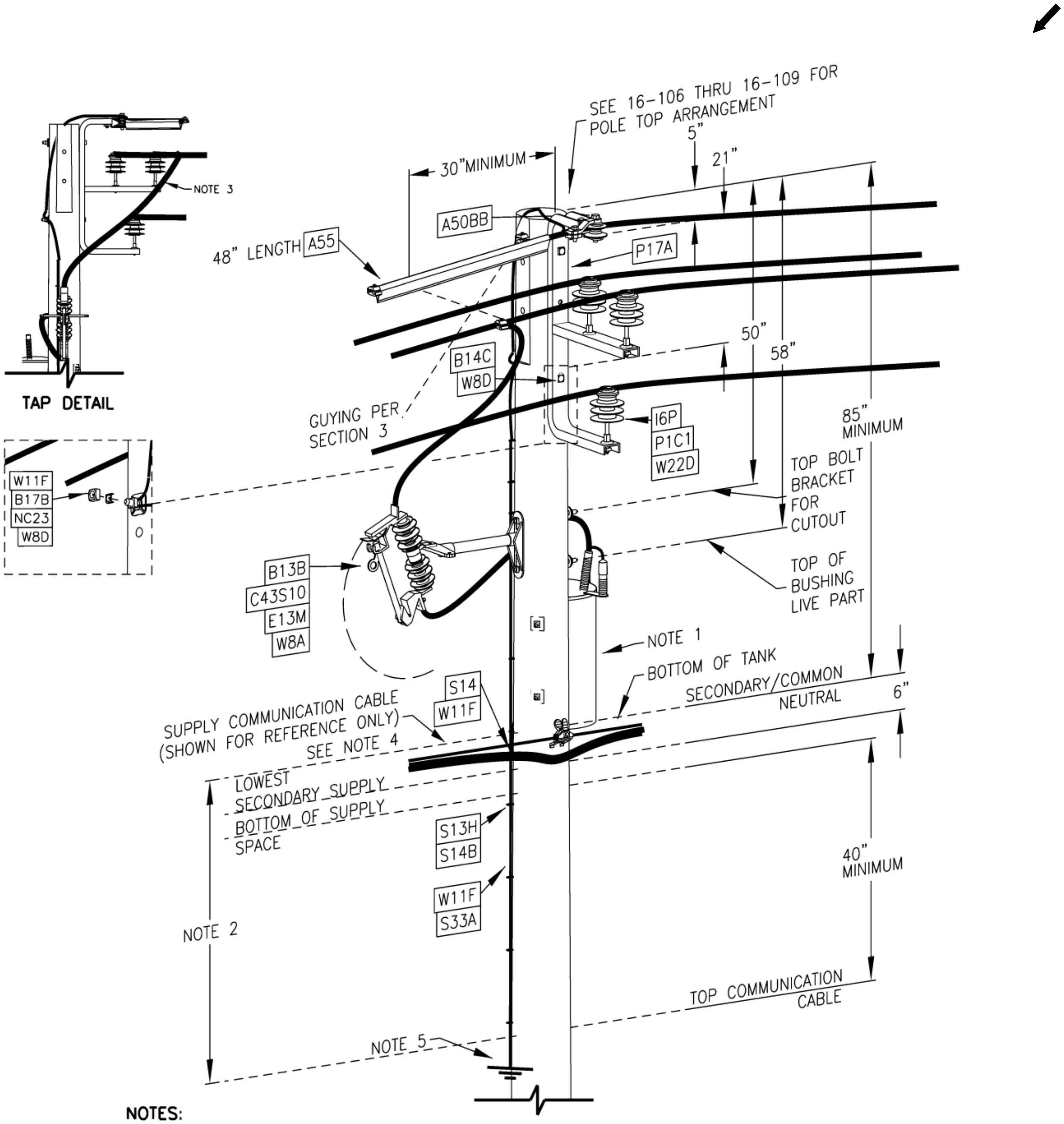
Supersedes 7/15 Issue – Updated drawing to 3D



NOTES:
1. SECONDARY TRANSFORMER CONNECTIONS NOT SHOWN.
2. MAINTAIN 30" MINIMUM – BOTTOM TANK TO TOP COMMUNICATION.
3. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
4. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S).
5. GROUNDING PER SECTION 13.
6. MINIMUM DIMENSION SHOWN FOR 1/ø SPACER CABLE CONDUCTOR ON A 40/40 JOINTLY OWNED POLE.

Designer	Drawing	Date
MPR	od16166	6/30/20

15KV LINE POLE – SINGLE PHASE TRANSFORMER WITH POLE TOP EXTENSION



NOTES:

1. SECONDARY TRANSFORMER CONNECTIONS NOT SHOWN.
2. MAINTAIN 30" MINIMUM – BOTTOM TANK TO TOP COMMUNICATION.
3. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
4. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S).
5. GROUNDING PER SECTION 13.

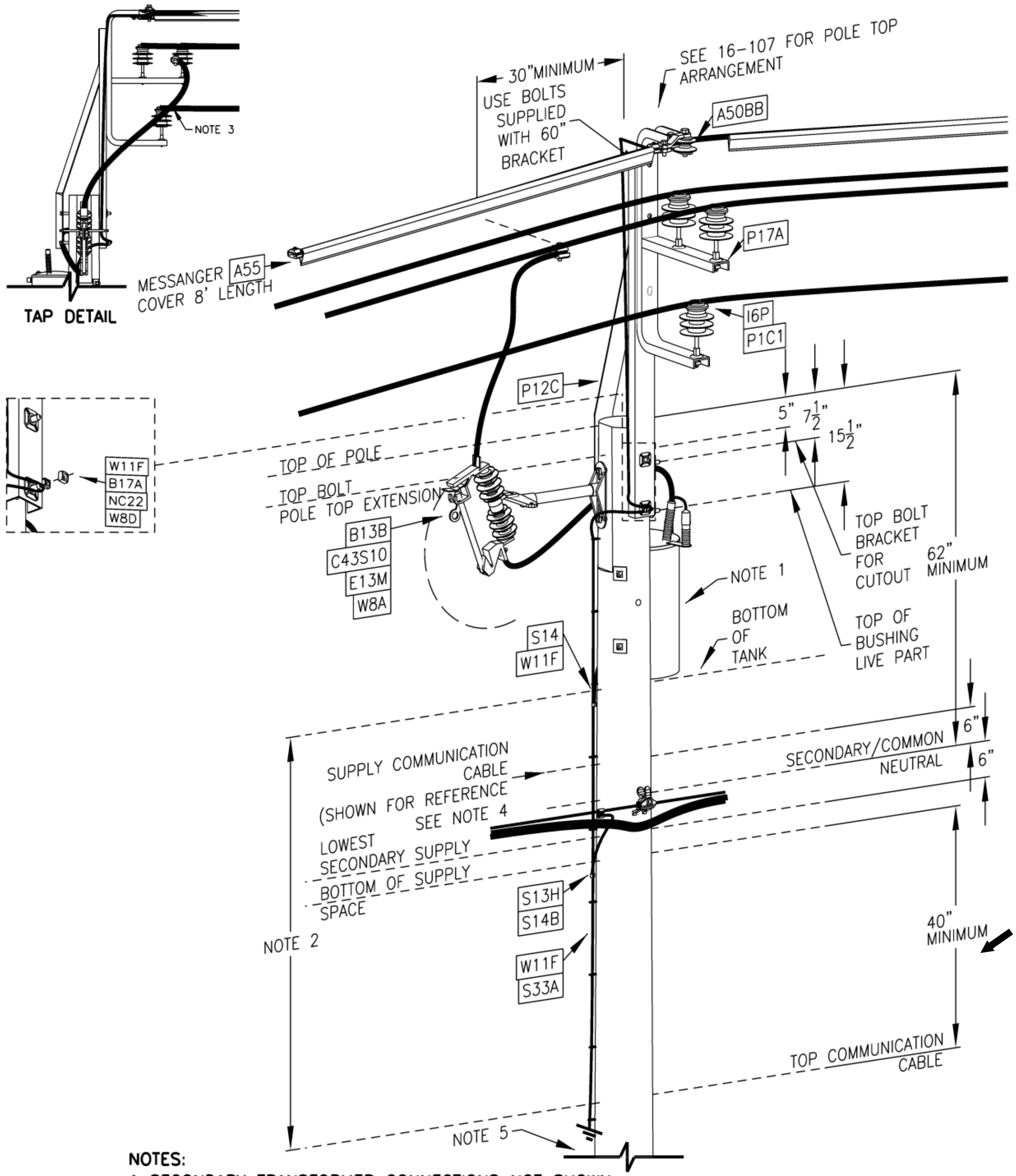
Designer	Drawing	Date
MPR	od16168	6/30/20

Supersedes 7/15 Issue – Updated drawing to 3D

15KV LINE POLE – SINGLE PHASE TRANSFORMER WITH E – BRACKET

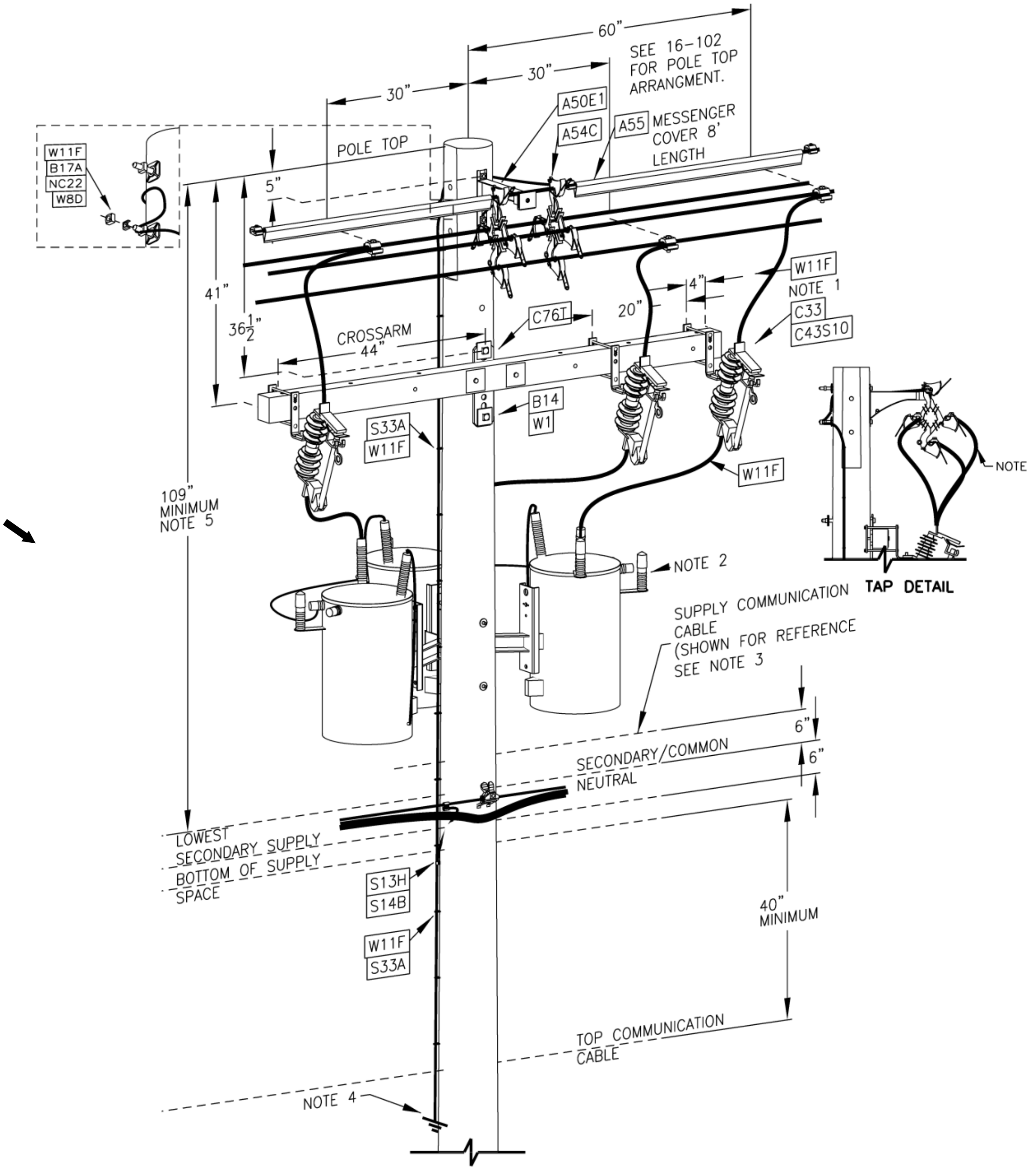
ISSUE	PAGE NUMBER		
7/20	16-168	OVERHEAD CONSTRUCTION STANDARD	ppl

Supersedes 7/15 Issue – Updated drawing to 3D



NOTES:
1. SECONDARY TRANSFORMER CONNECTIONS NOT SHOWN.
2. MAINTAIN 30" MINIMUM – BOTTOM TANK TO TOP COMMUNICATION.
3. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
4. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S).
5. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16169	6/30/20



NOTES:

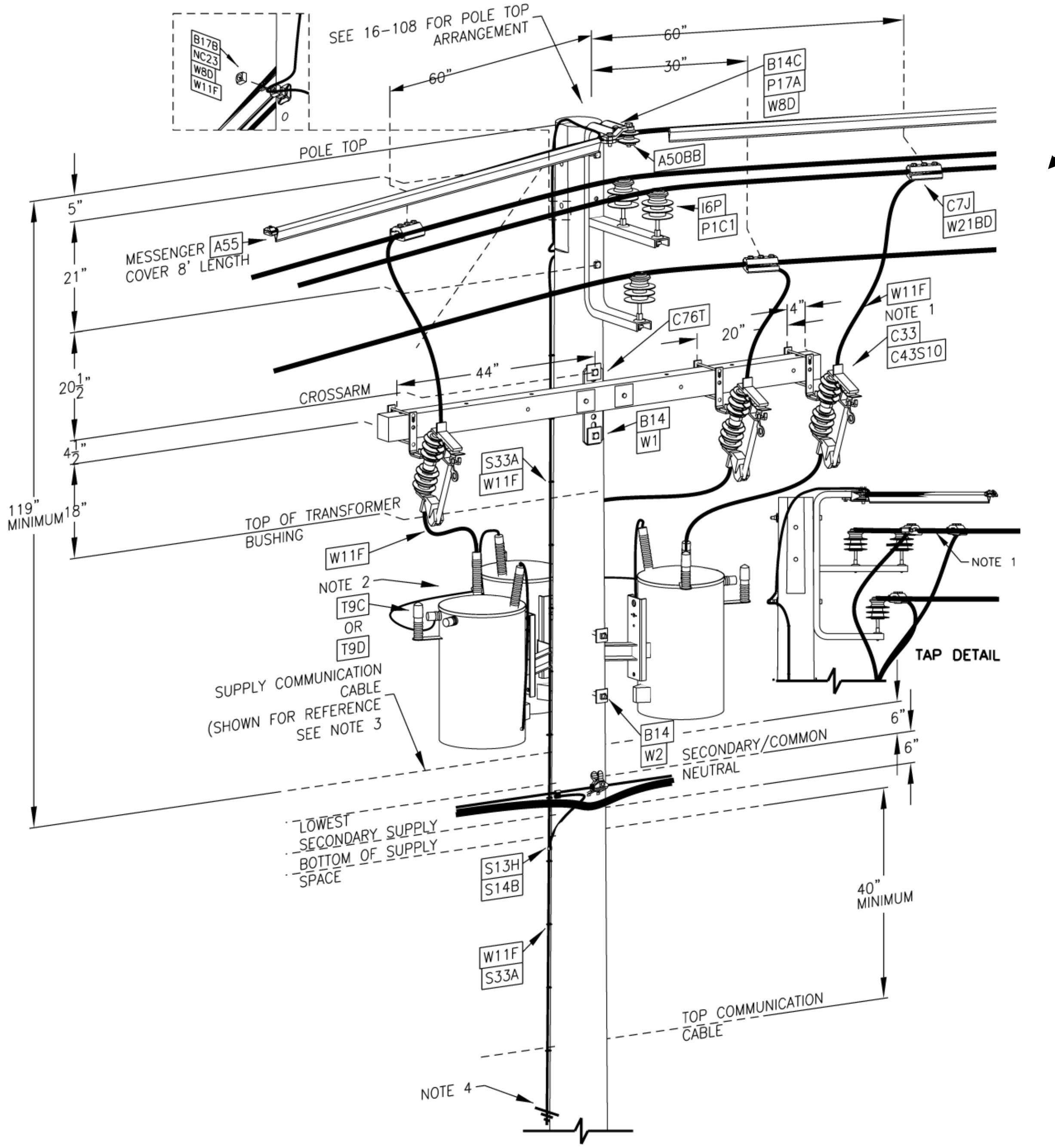
1. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
2. SECONDARY TRANSFORMER CONNECTIONS NOT SHOWN.
3. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S).
4. GROUNDING PER SECTION 13.
5. MINIMUM DIMENSION SHOWN FOR 1/Ø SPACER CABLE CONDUCTOR ON A 45/40 JOINTLY OWNED POLE.

Designer	Drawing	Date
MPR	od16171	1/15/21

Supersedes 7/20 Issue – Corrected part number to C33.

15KV STRAIGHT LINE POLE – THREE PHASE TRANSFORMER BANK

Supersedes 7/20 Issue – Corrected part number to C33.



NOTES:
1. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 8" CLEARANCE TO ANY OTHER SPACER CABLE PHASE (12" FOR 35KV).
2. SECONDARY TRANSFORMER CONNECTIONS NOT SHOWN.
3. POLE NOT SPECIFICALLY DESIGNED TO ACCOMMODATE SUPPLY COMMUNICATION CABLE(S).
4. GROUNDING PER SECTION 13.

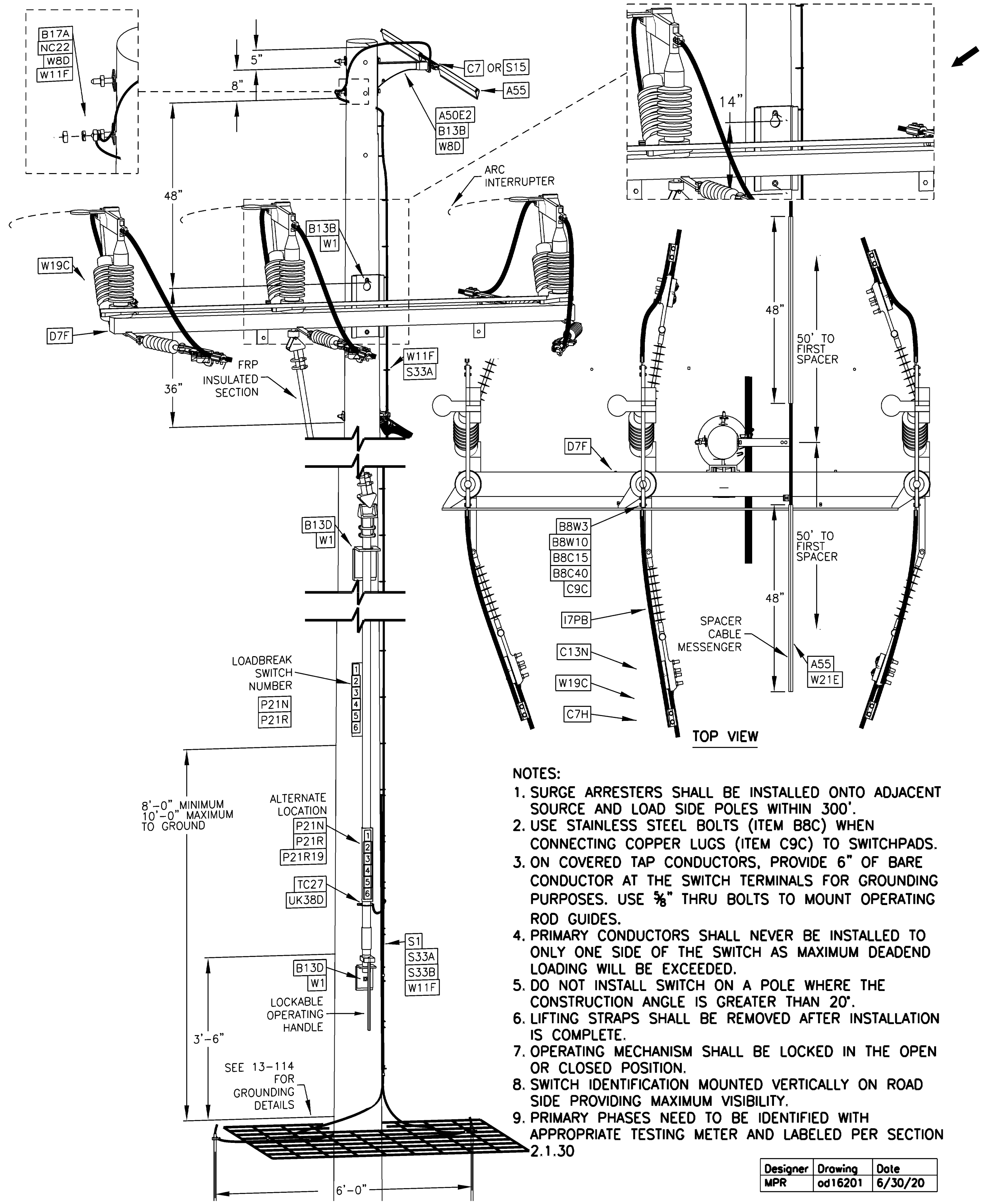
Designer	Drawing	Date
MPR	od16173	1/15/21

15KV LINE POLE – SINGLE PHASE TRANSFORMER WITH E – BRACKET ON POLE TOP EXTENSION			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER: 16-173	ISSUE: 7/21

Spacer Cable Construction Drawings

23 kV & 35 kV Grounded Distribution Systems

Supersedes 7/09 Issue – Updated drawing to 3D

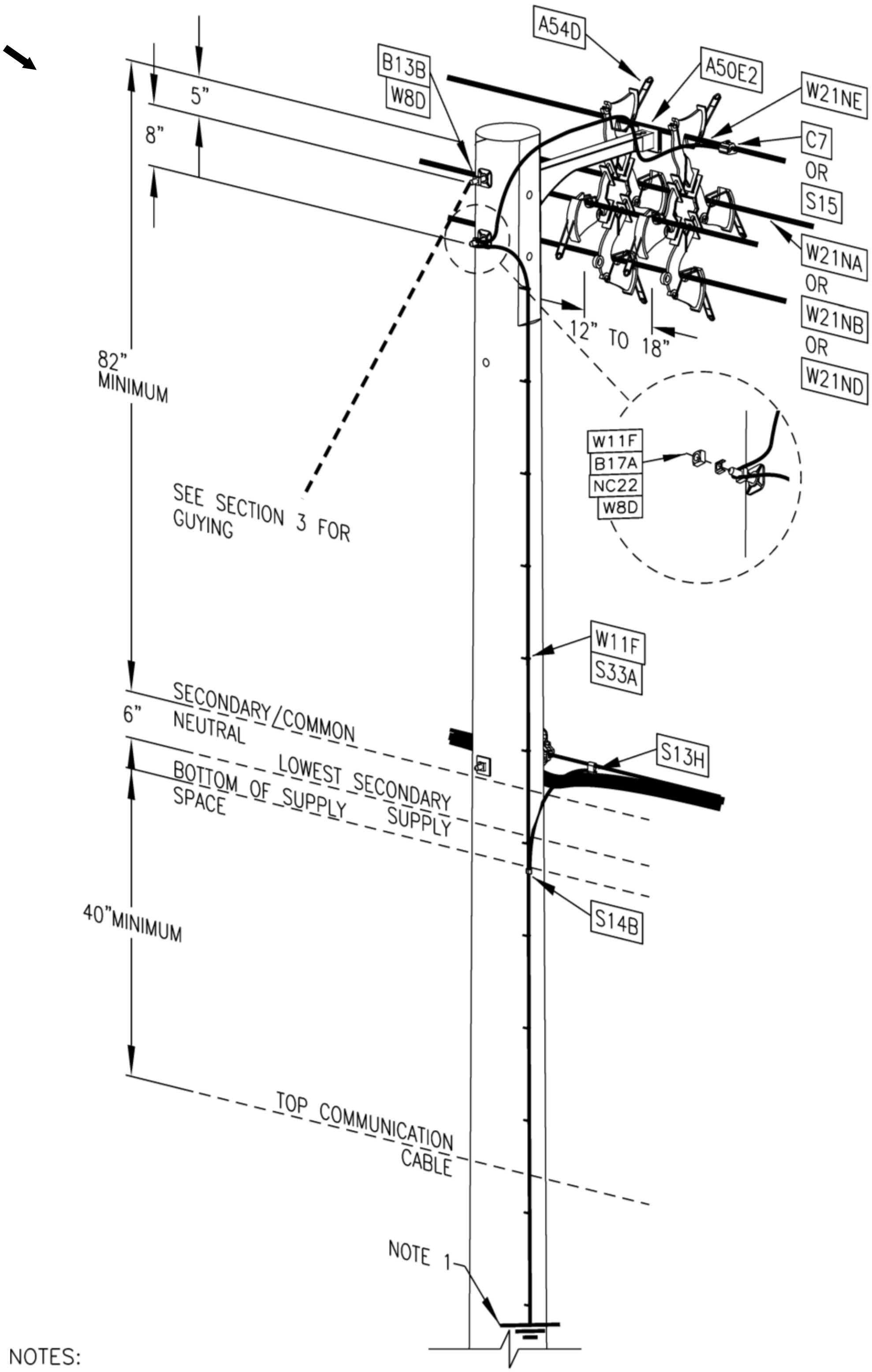


NOTES:
1. SURGE ARRESTERS SHALL BE INSTALLED ONTO ADJACENT SOURCE AND LOAD SIDE POLES WITHIN 300'.
2. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCHPADS.
3. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE ⅝" THRU BOLTS TO MOUNT OPERATING ROD GUIDES.
4. PRIMARY CONDUCTORS SHALL NEVER BE INSTALLED TO ONLY ONE SIDE OF THE SWITCH AS MAXIMUM DEADEND LOADING WILL BE EXCEEDED.
5. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°.
6. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
7. OPERATING MECHANISM SHALL BE LOCKED IN THE OPEN OR CLOSED POSITION.
8. SWITCH IDENTIFICATION MOUNTED VERTICALLY ON ROAD SIDE PROVIDING MAXIMUM VISIBILITY.
9. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od16201	6/30/20

35KV PREASSEMBLED LOADBREAK SWITCH

MU = @16-205C(Y)	0-35 kV, 24" Tan., (Y) = Wire Size



NOTES:
1. GROUNDING PER SECTION 13.
2. OPEN SPACER MUST BE PLACED MIDSPAN.

Designer	Drawing	Date
MPR	od16205	6/30/20

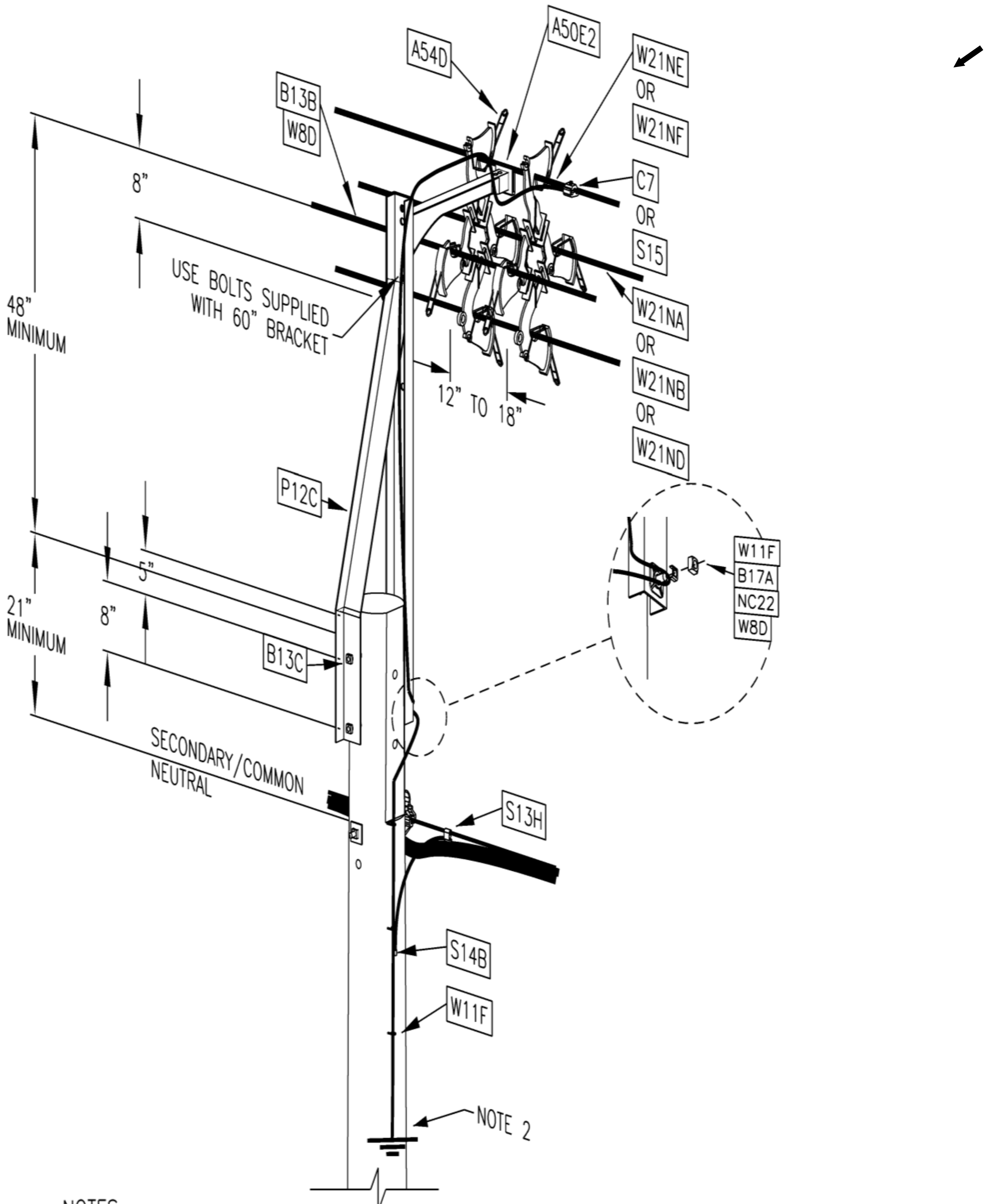
Supersedes 7/15 Issue – Updated drawing to 3D

35KV LINE POLE ATTACHMENT FOR 40' OR 45' POLE			
ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/20	16-205		

Business Use

MU = @16-206C(Y)	0-35 kV, 24" Tan., (Y) = Wire Size

Supersedes 7/15 Issue – Updated drawing to 3D.

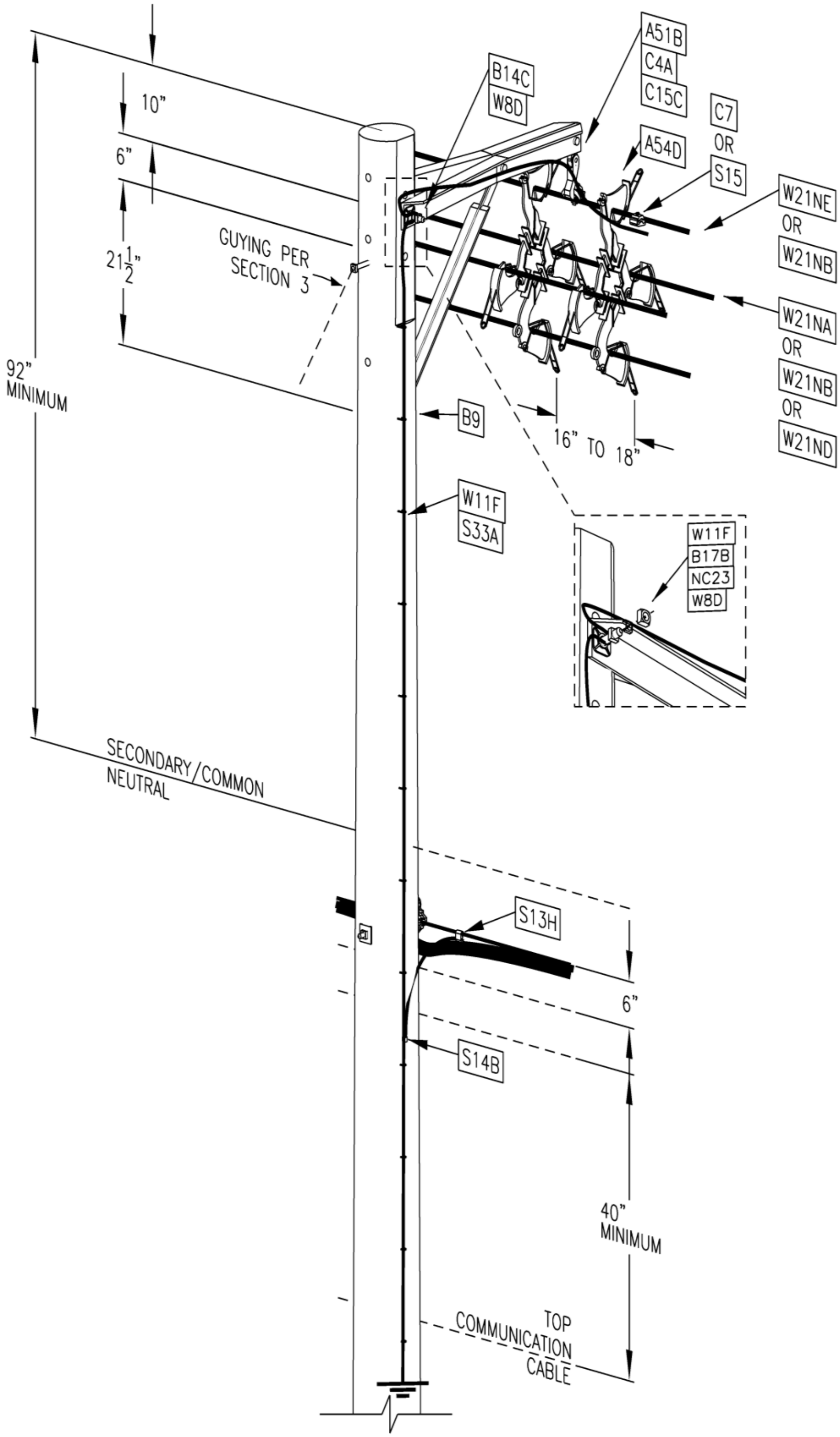


NOTES:
1. ONE SPACER MUST BE PLACED MIDSPAN.
2. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16206	6/30/20

35KV LINE POLE ATTACHMENT WITH POLE TOP EXTENSION FOR 35' OR 40' POLE			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER: 16-206	ISSUE: 7/20

MU = @16-210C(Y)	0-35 kV, 44” Tan., (Y) = Wire Size



Designer	Drawing	Date
MPR	od16210	6/30/20

Supersedes 7/15 Issue – Updated drawing to 3D

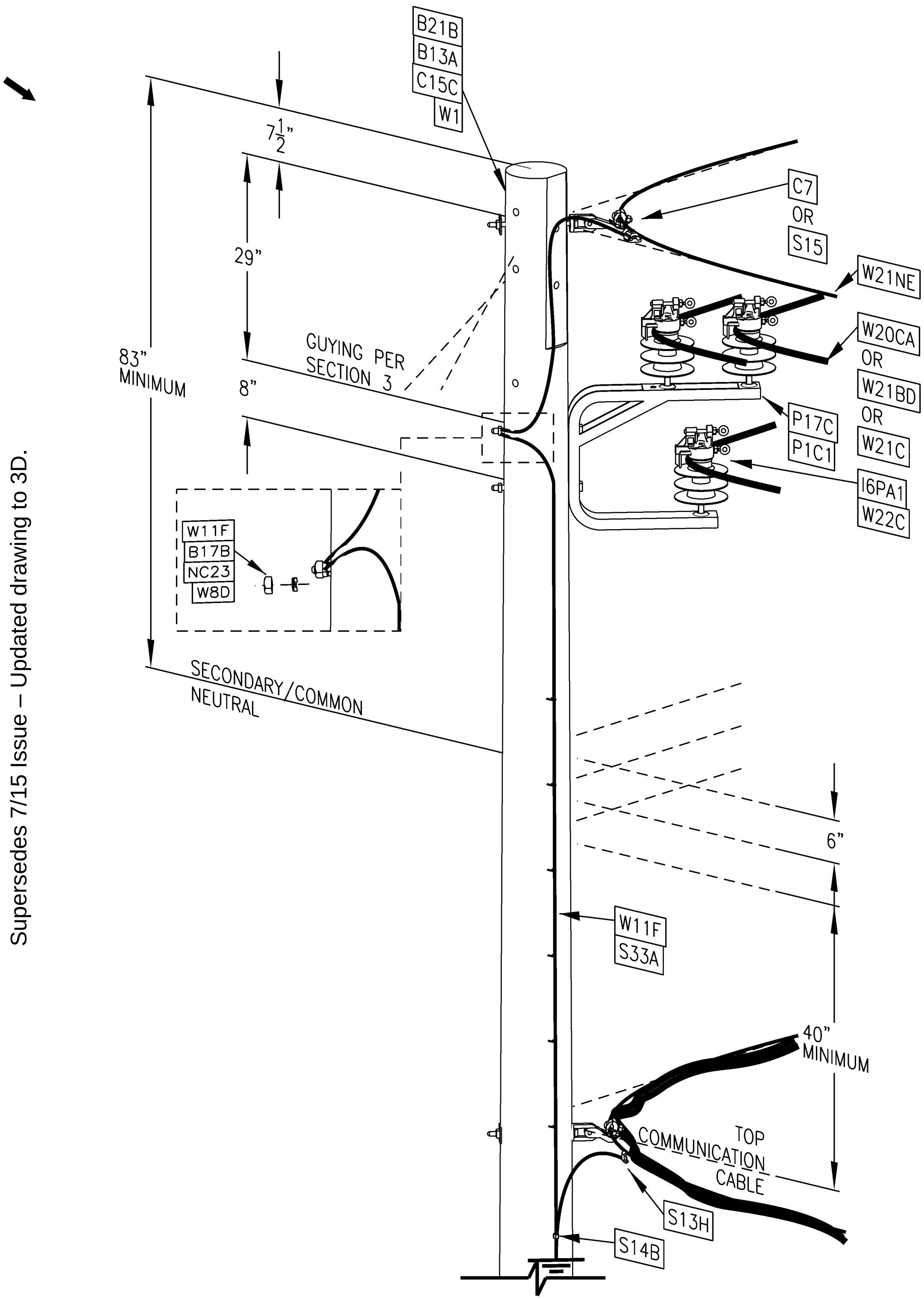
35KV LINE POLE ATTACHMENT – 44” EXTENSION BRACKET

ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD
7/20	16-210	

Business Use

MU = @16-213C(Y)	0-35 kV, C Brkt., (Y) = Wire Size

Supersedes 7/15 Issue – Updated drawing to 3D.

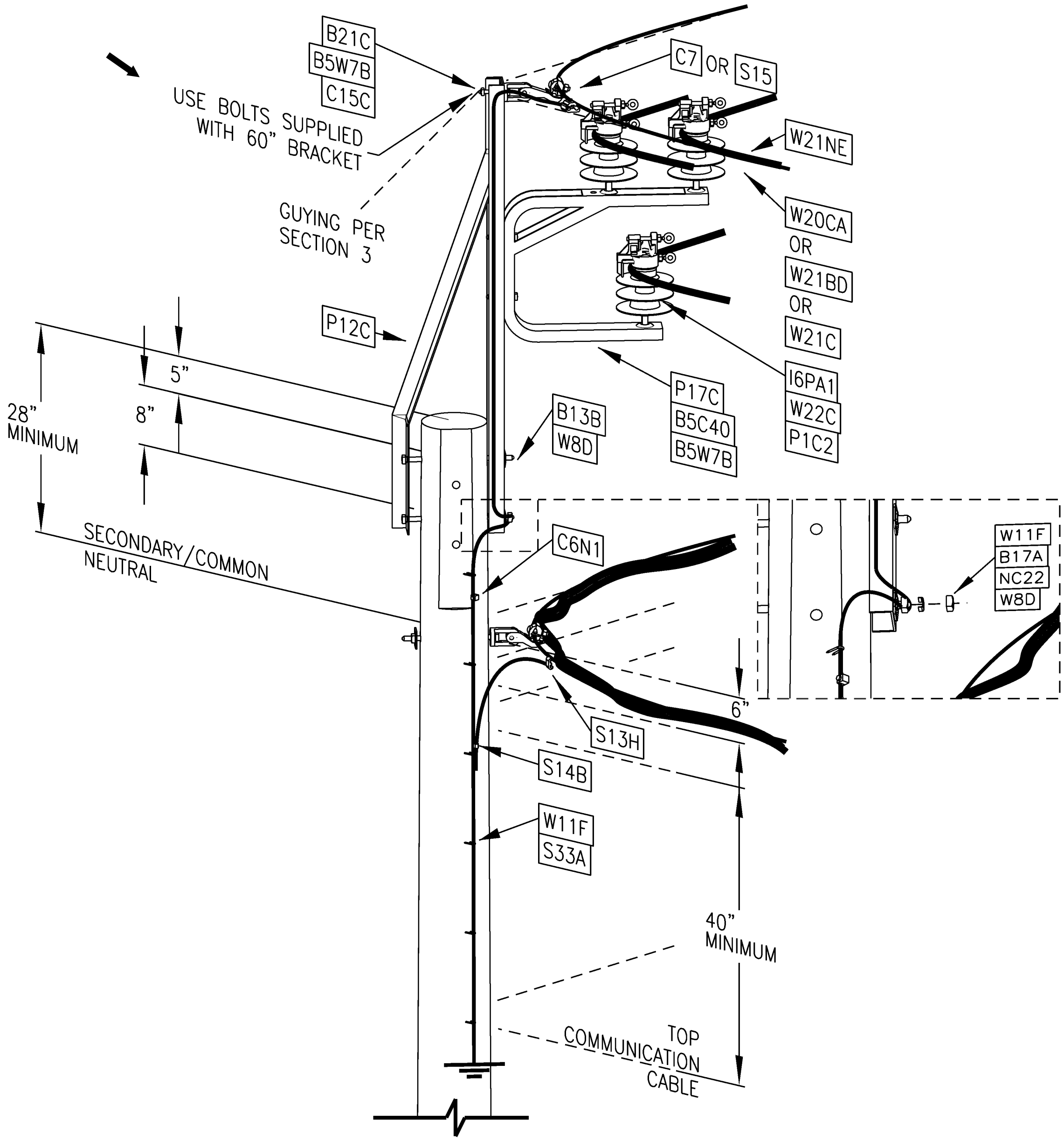


Designer	Drawing	Date
MPR	od16213	7/16/20

35KV CORNER POLE ATTACHMENT FOR 40' OR 45' POLE			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 16-213	ISSUE 7/20

Business Use

MU = @16-214C(Y)	0-35 kV, C Brkt., (Y) = Wire Size



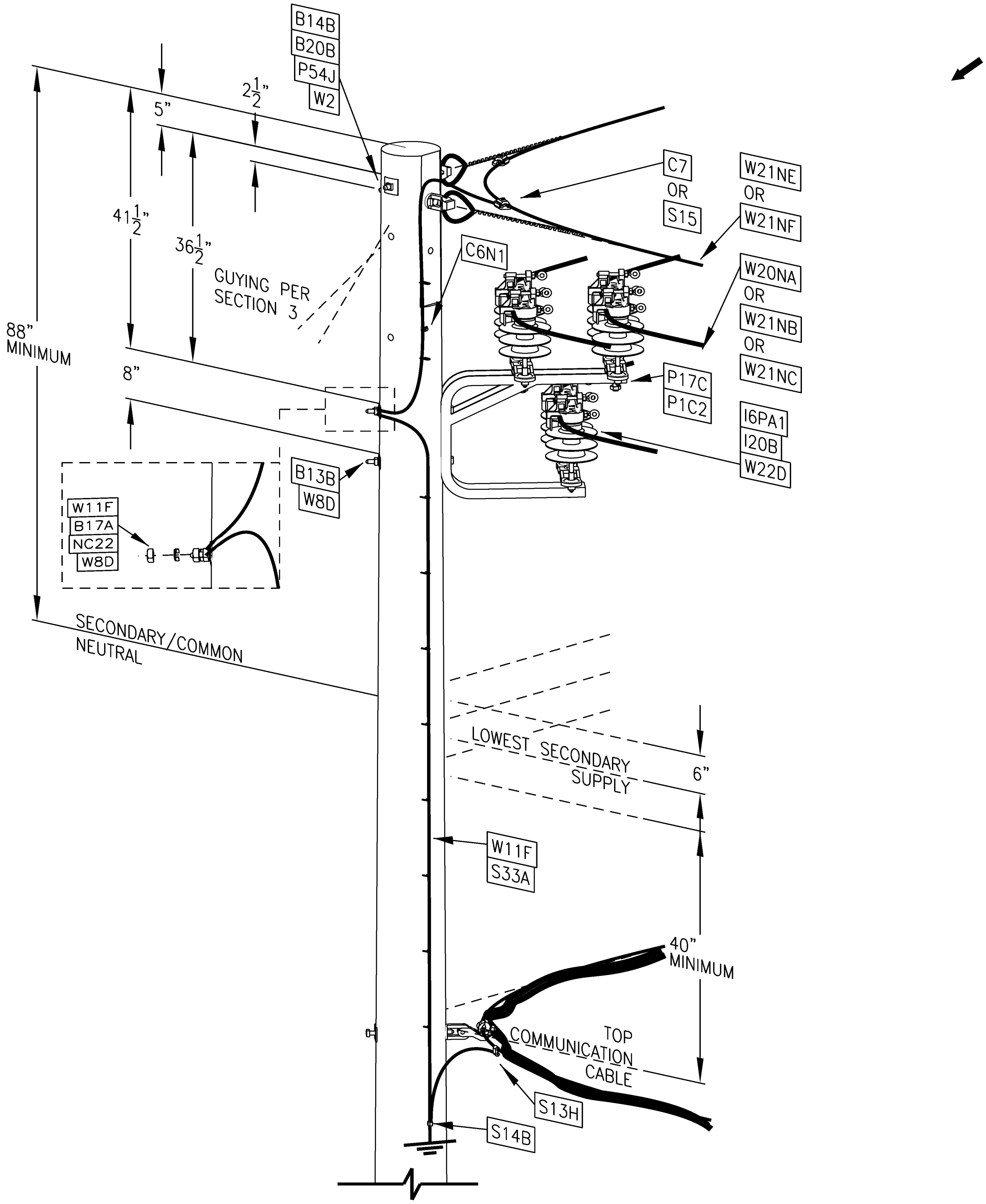
Supersedes 7/15 Issue – Updated drawing to 3D

Designer	Drawing	Date
MPR	od16214	7/16/20

35KV CORNER POLE ATTACHMENT USING POLE TOP EXTENSION FOR 35' POLE

ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/20	16-214		

MU = @16-217C(Y)	0-35 kV, C Brkt., (Y) = Wire Size



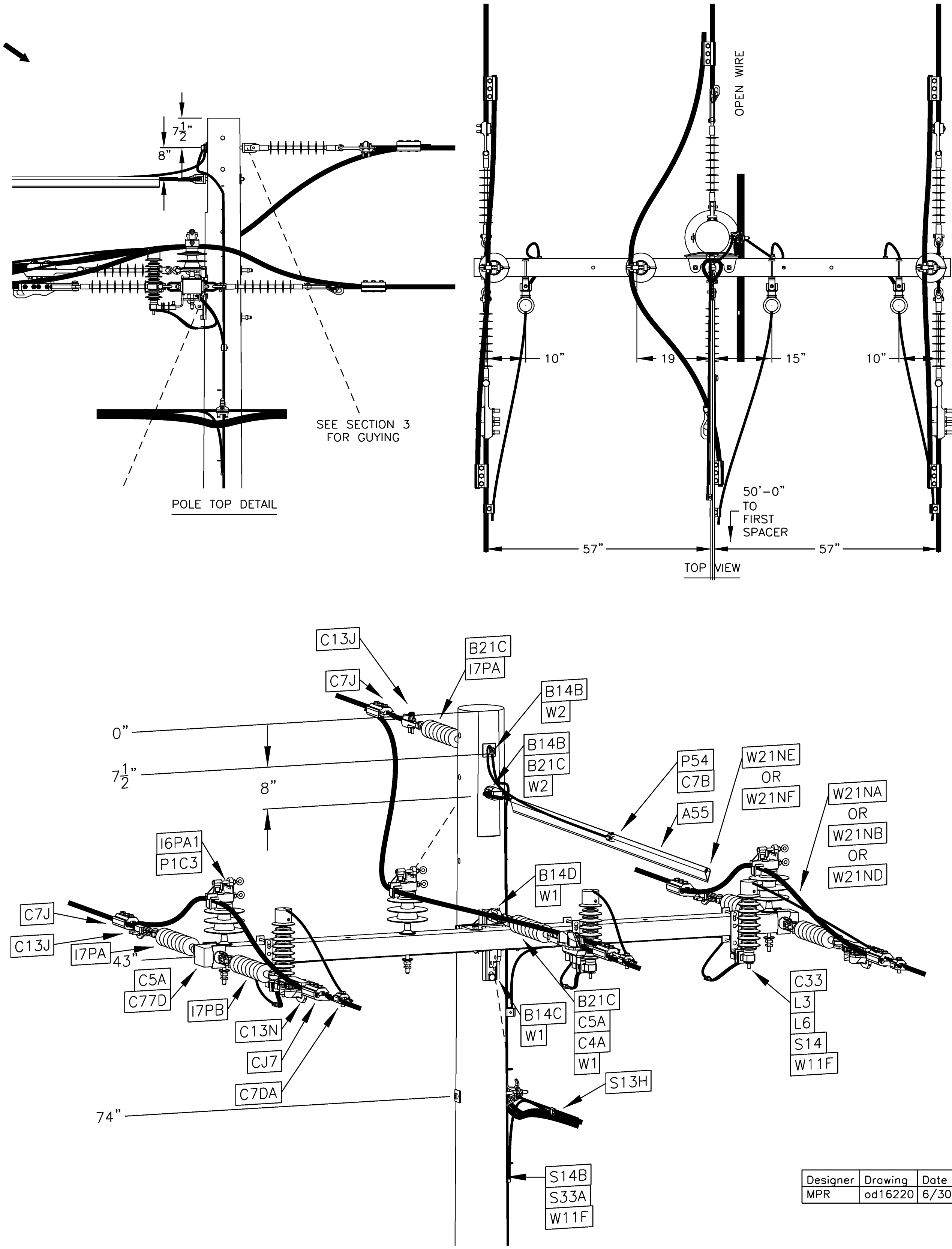
Supersedes 7/15 Issue – Updated drawing to 3D

Designer	Drawing	Date
MPR	od16217	7/16/20

35KV CORNER POLE ATTACHMENT FOR 40' OR 45' POLE – LINE ANGLES 61˚ - 90˚

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	16-217	7/20

MU = @16-220C(Y)	0-35 kV, Crossarm., (Y) = Wire Size



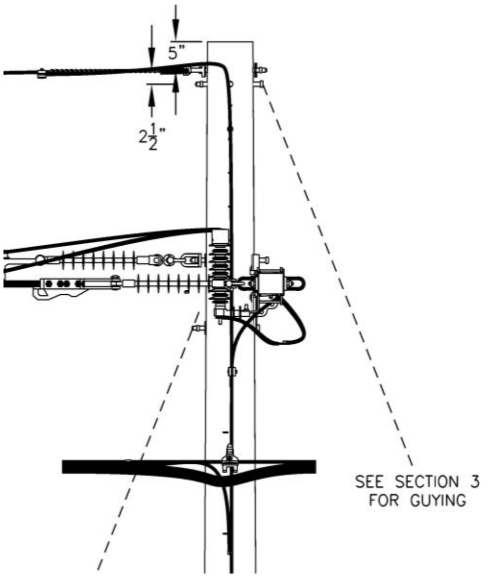
Designer	Drawing	Date
MPR	od16220	6/30/20

Supersedes 7/13 Issue – Updated drawing to 3D

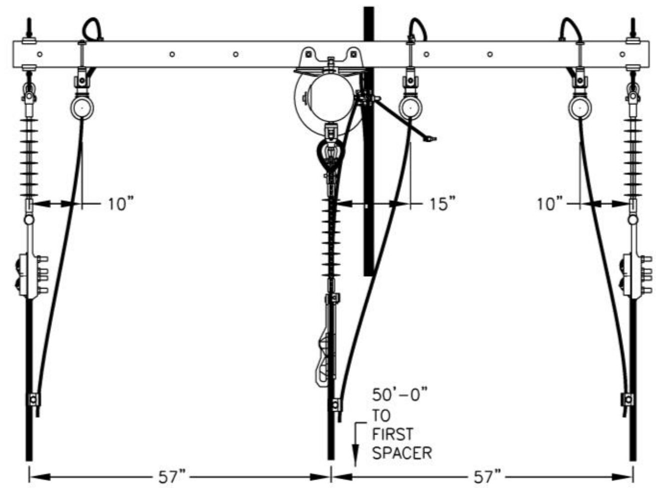
35 KV CONNECTION TO OPEN WIRE FOR 40' OR 45' POLE

ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	
7/20	16-220		

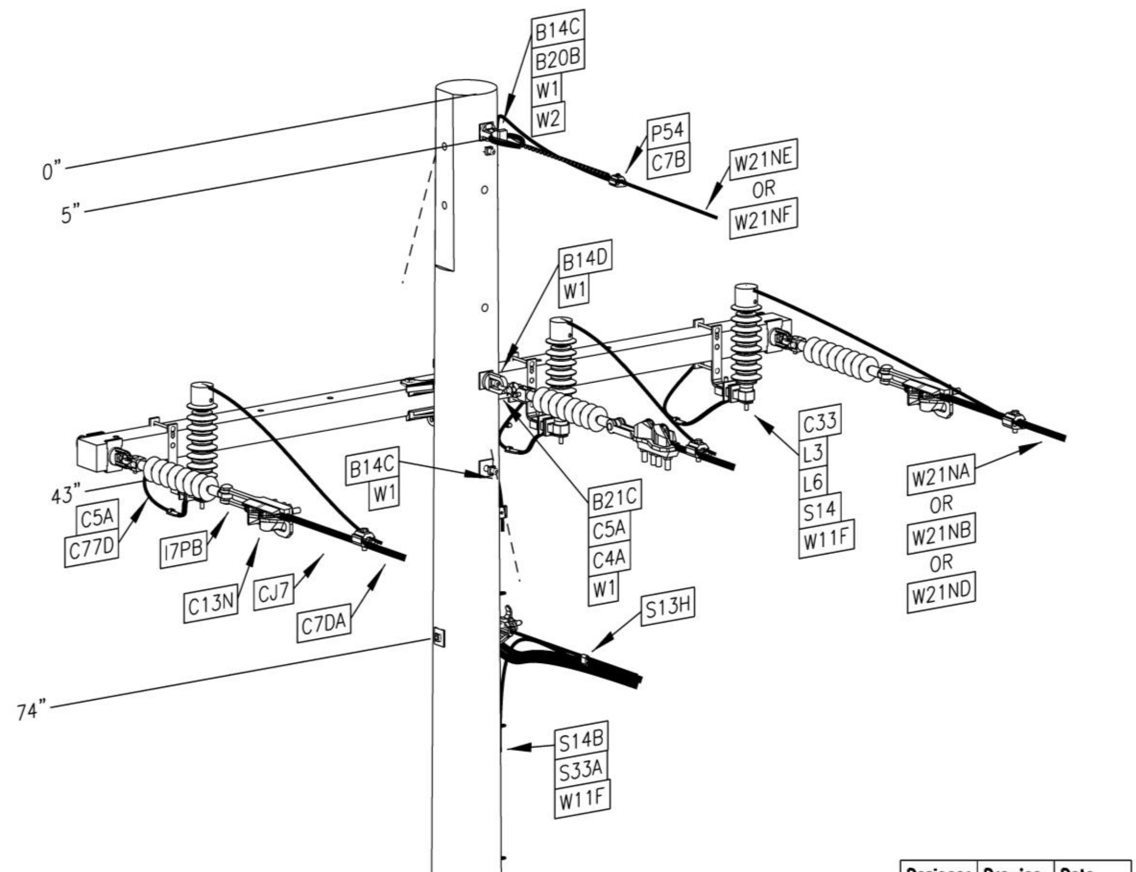
Supersedes 7/09 Issue – Updated drawing to 3D



POLE TOP DETAIL

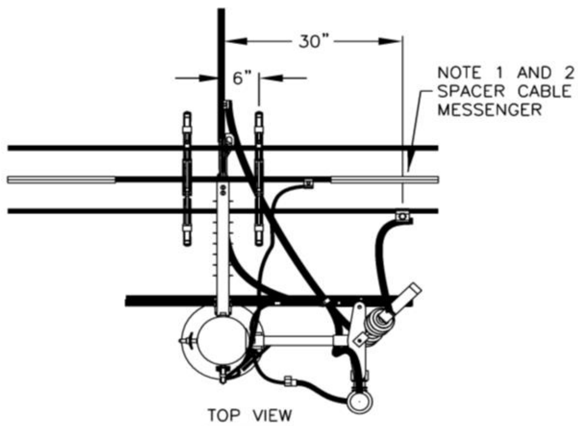


TOP VIEW

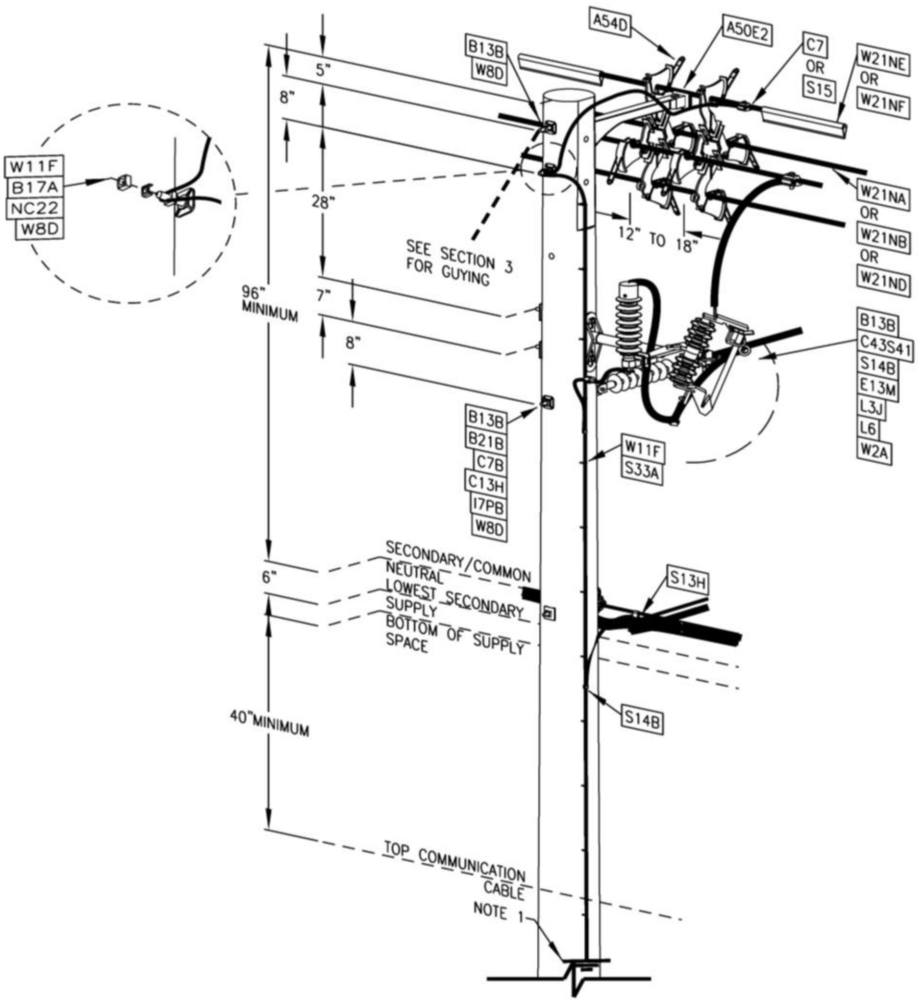


Designer	Drawing	Date
MPR	od16223	6/30/20

MU = @16-226W1/0TC(Y)	0-35 kV, 24" Tan., (Y) = Wire Size



TOP VIEW



NOTES:

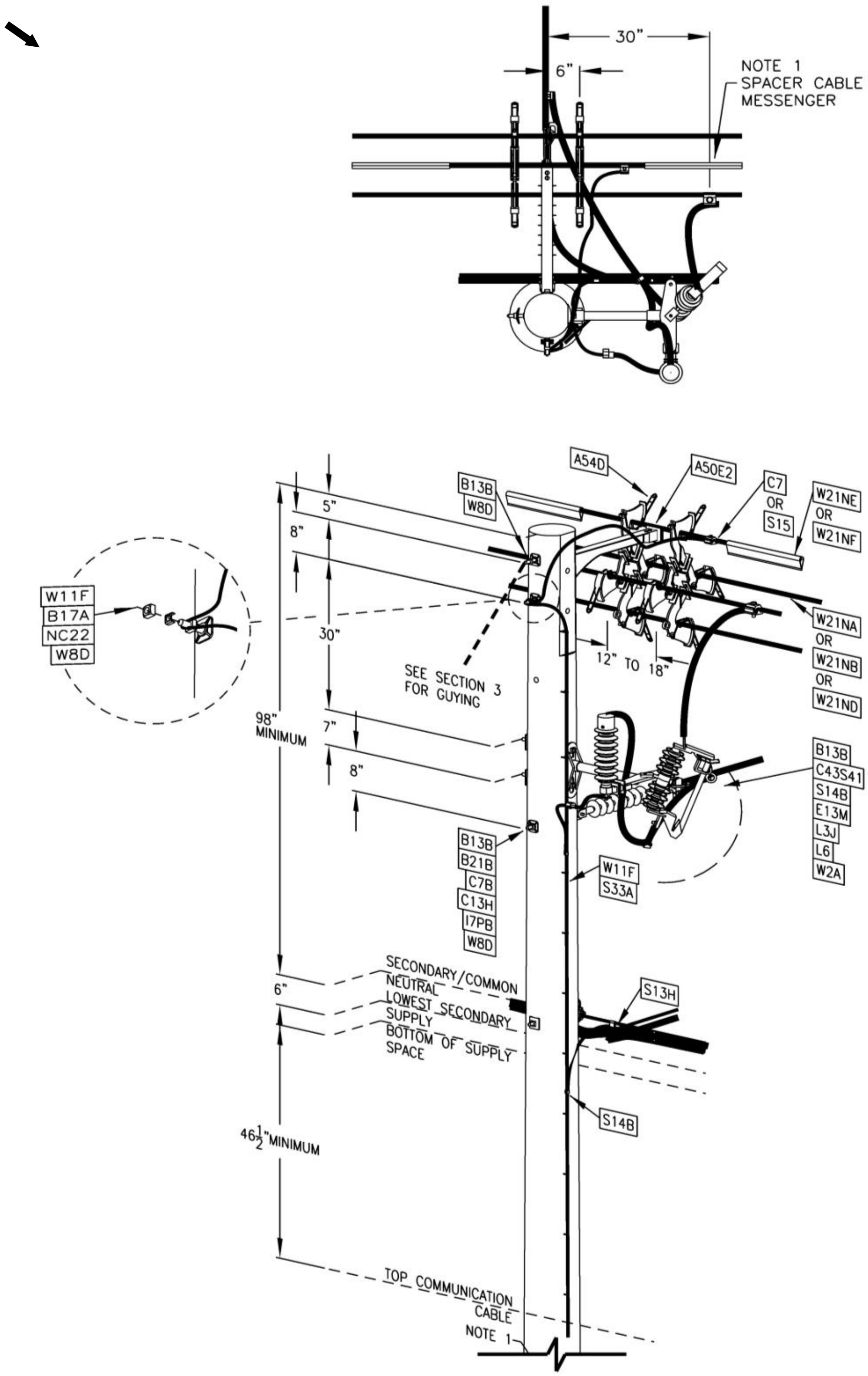
1. MESSENGER COVERING TO EXTEND A MINIMUM OF 12" EACH SIDE OF TAP CONNECTION
2. 125' MAXIMUM IF NO FUTURE CROSSARM USED ON LINE POLE ONE SPAN AWAY.

Designer	Drawing	Date
MPR	od16226	6/30/20

Supersedes 7/15 Issue – Updated drawing to 3D

35KV LINE POLE ATTACHEMENT TO SINGLE PHASE OPEN WIRE TAP FOR 40' POLE			
ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/20	16-226		

Supersedes 7/15 Issue – Updated drawing to 3D

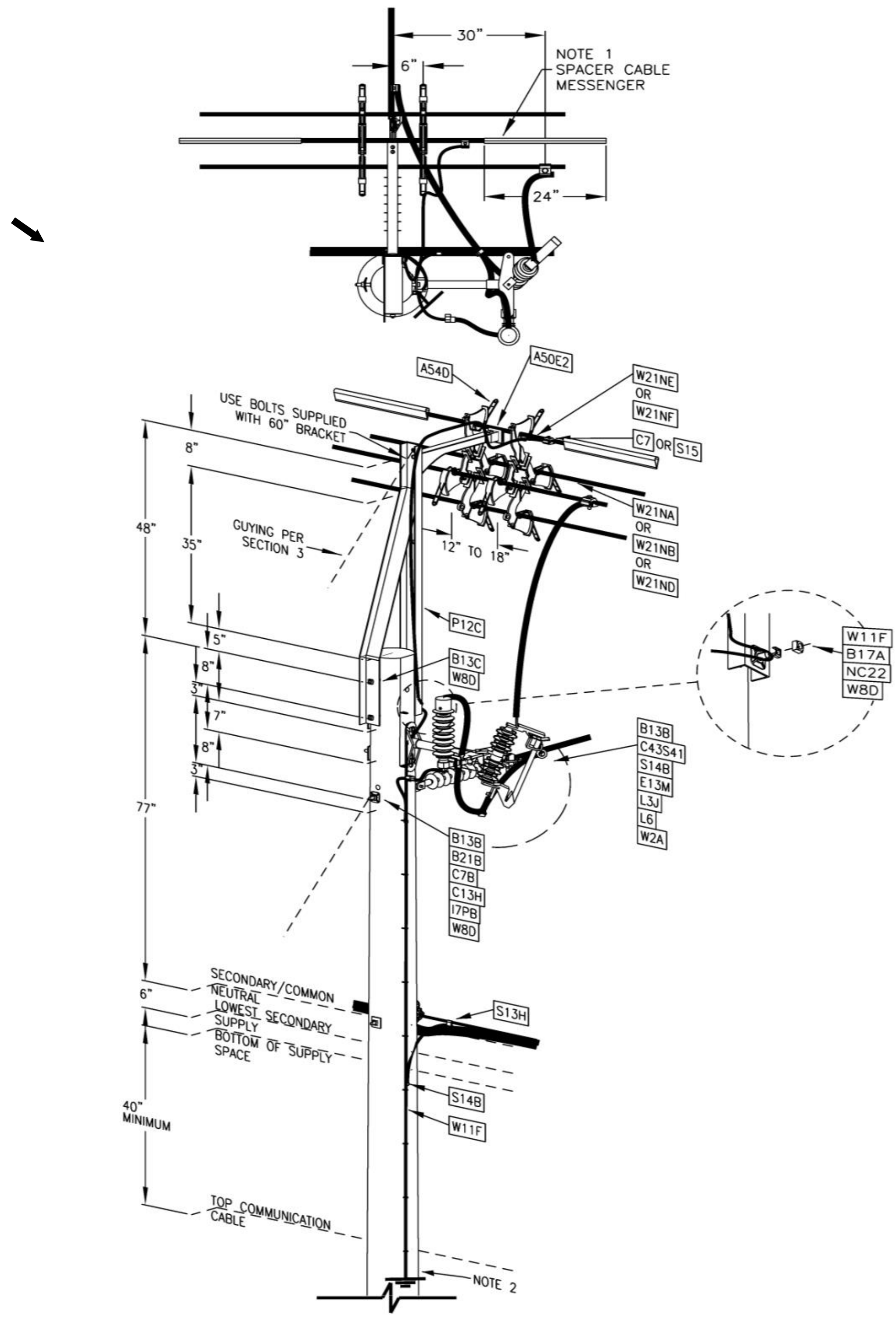


NOTES:
1. MESSENGER COVERING TO EXTEND A MINIMUM OF 12" EACH SIDE OF TAP CONNECTION

Designer	Drawing	Date
MPR	od16227	6/30/20

35KV LINE POLE ATTACHEMENT TO SINGLE PHASE OPEN WIRE TAP FOR 45' POLE			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER: 16-227	ISSUE: 7/20

MU = @16-228W1/0TC(Y)	0-35 kV, 24" Tan., (Y) = Wire Size



Supersedes 7/15 Issue – Updated drawing to 3D

NOTES:

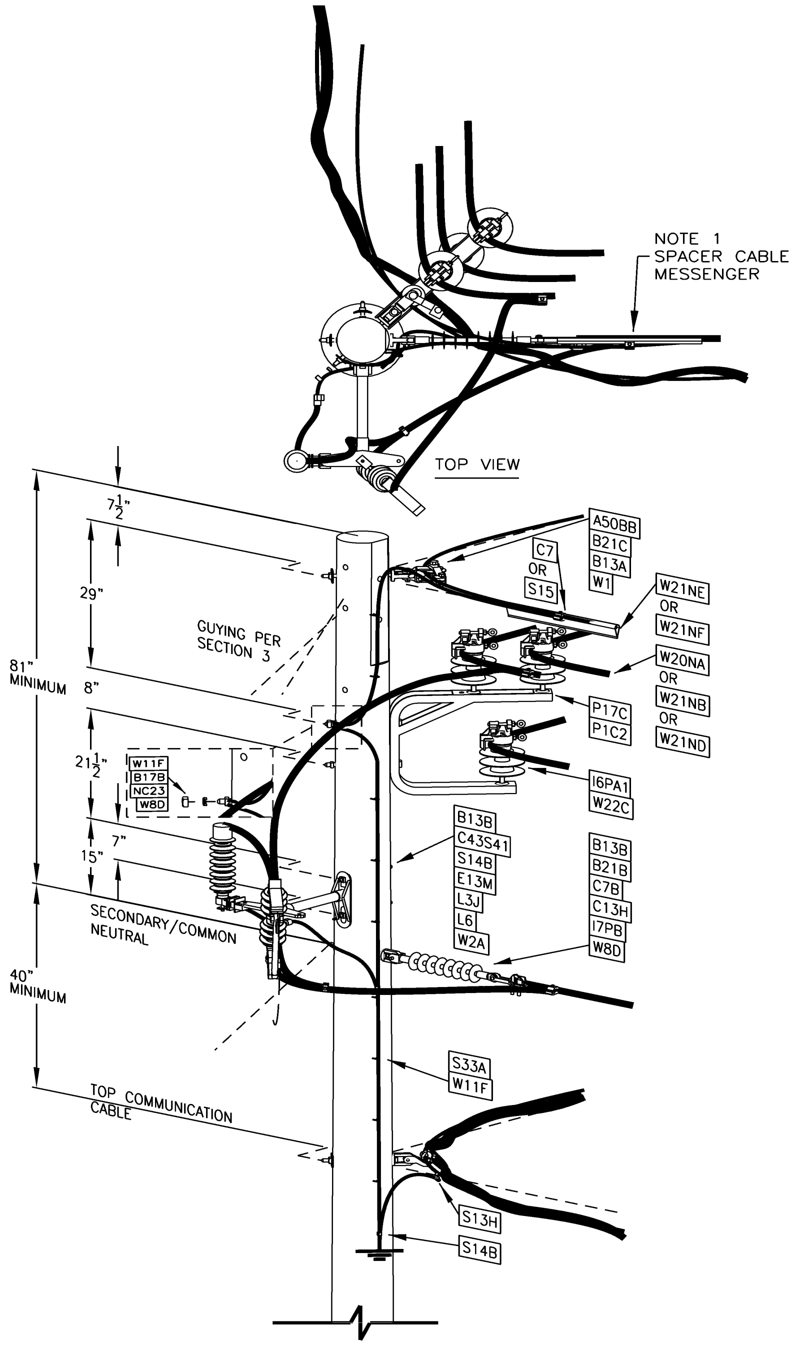
1. MESSENGER COVERING TO EXTEND 12" MINIMUM EACH SIDE OF TAP CONNECTION.
2. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16228	6/30/20

35KV LINE POLE ATTACHEMENT TO SINGLE PHASE OPEN WIRE TAP FOR 40' POLE WITH POLE TOP EXTENSION			
ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/20	16-228		

MU = @16-232W1/0TC(Y)	0-35 kV, C Brkt., (Y) = Wire Size

Supersedes 7/15 Issue – Updated drawing to 3D

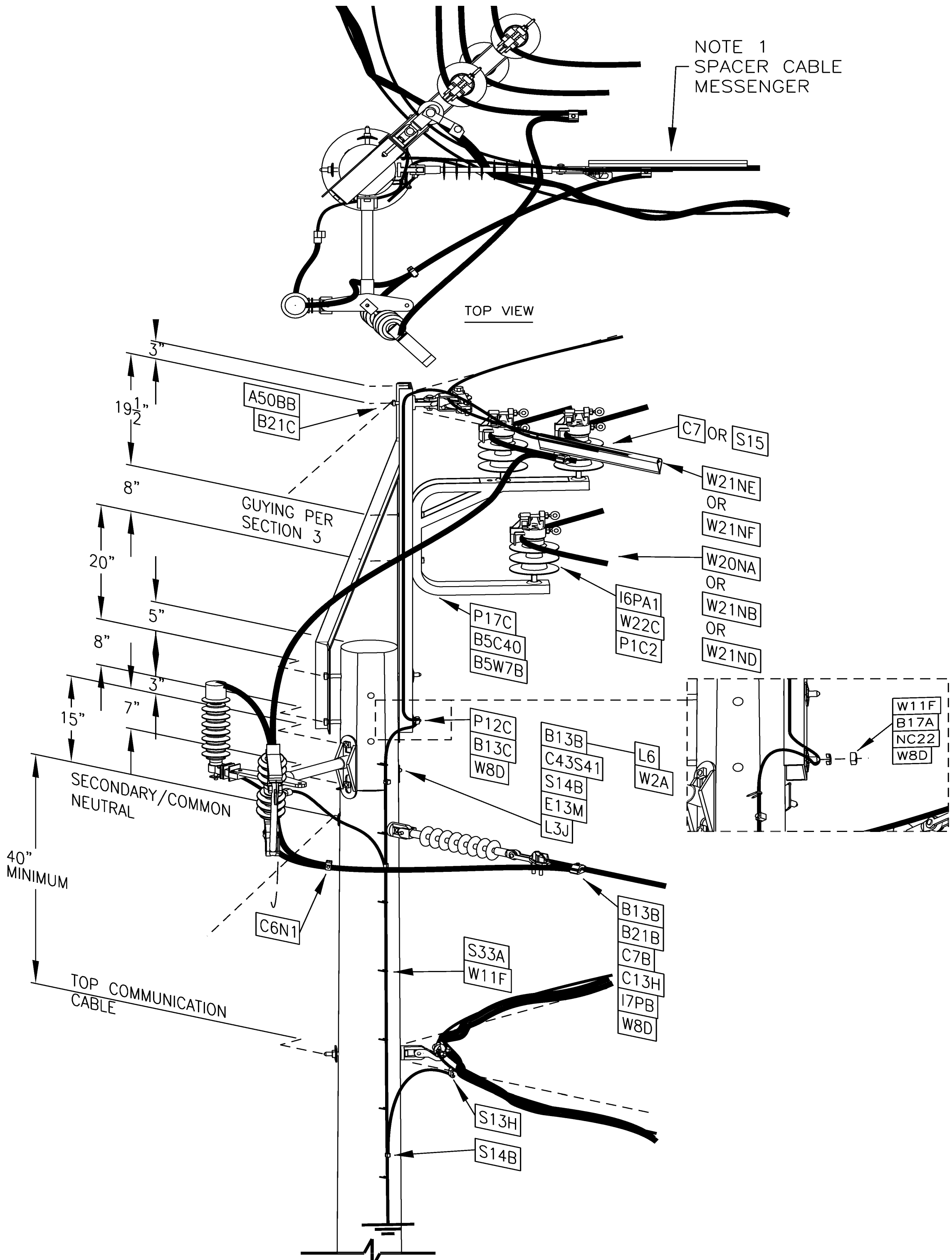


NOTES:
1. MESSENGER COVERING TO EXTEND 12" MINIMUM EACH SIDE OF TAP CONNECTION.
2. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16232	7/16/30

35KV CORNER POLE ATTACHEMENT TO SINGLE PHASE OPEN WIRE TAP FOR 45' POLE			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER: 16-232	ISSUE: 7/20

MU = @16-233W1/0TC(Y)	0-35 kV, C Brkt., (Y) = Wire Size



Supersedes 7/15 Issue – Updated drawing to 3D

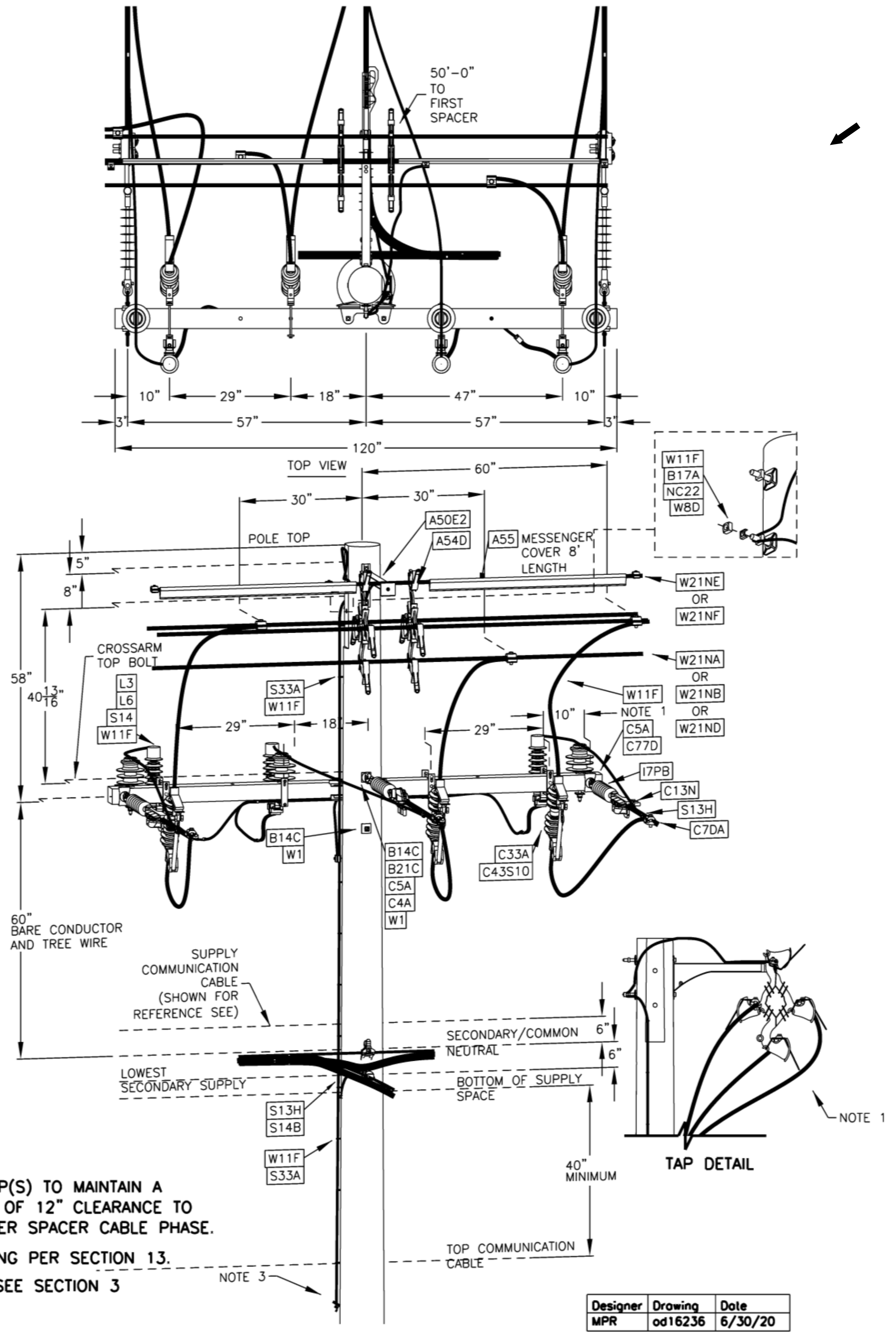
NOTES:
1. MESSENGER COVERING TO EXTEND 12" MINIMUM EACH SIDE OF TAP CONNECTION.
2. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16233	7/16/20

35KV CORNER POLE ATTACHEMENT TO SINGLE PHASE OPEN WIRE TAP FOR 40' POLE WITH POLE TOP EXTENSION			
ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/20	16-233		

MU = @16-236C(Y)	0-35 kV, 24" Tan., (Y) = Wire Size	MU = @16-2362PHC(Y)	0-35 kV, 24" Tan., 2 Ph. Jct., (Y) = Wire Size

Supersedes 7/15 Issue – Updated drawing to 3D

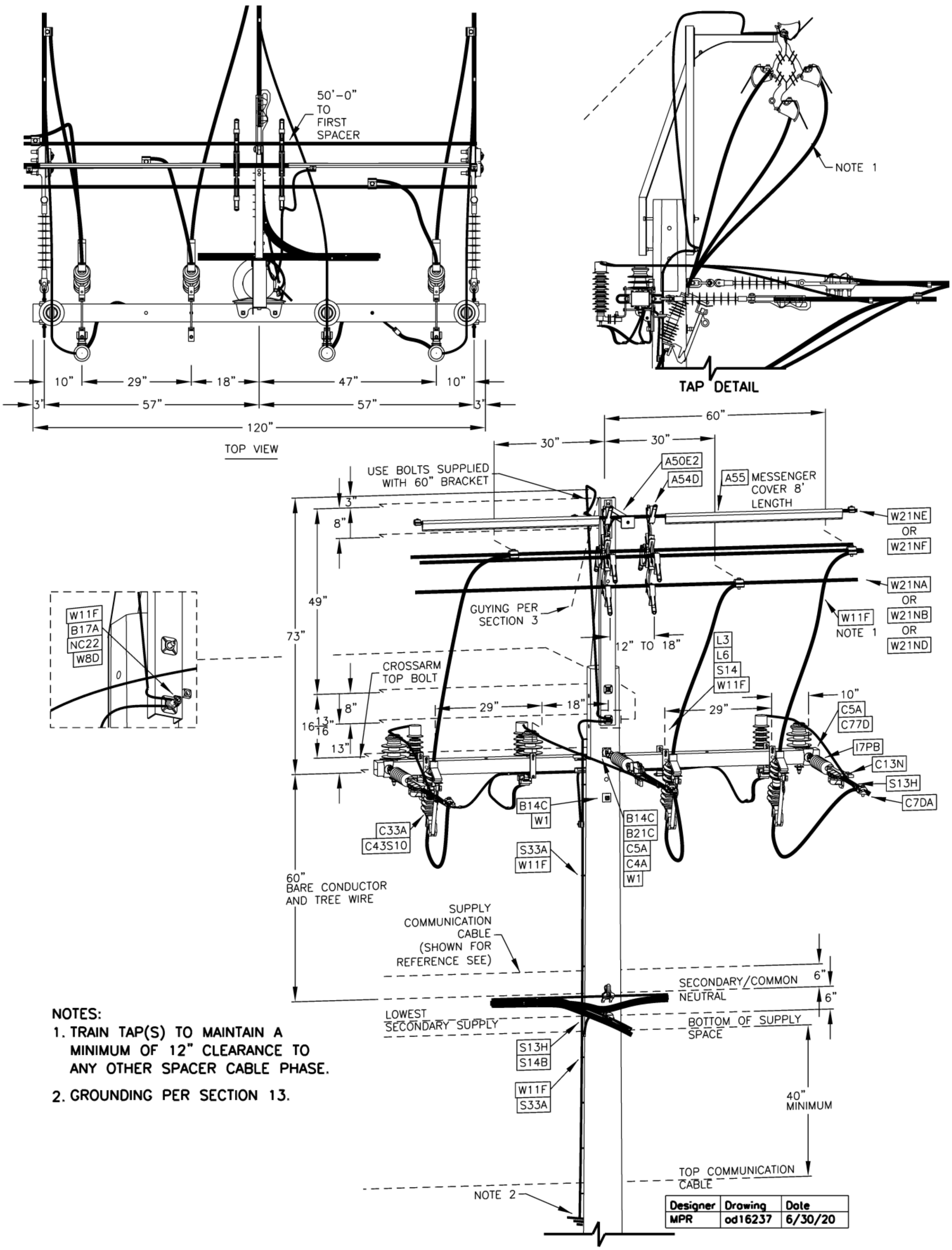


NOTES:

1. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 12" CLEARANCE TO ANY OTHER SPACER CABLE PHASE.
2. GROUNDING PER SECTION 13.
3. GUYING SEE SECTION 3

35KV LINE POLE ATTACHEMENT TO THREE PHASE OPEN WIRE TAP FOR 45' POLE

MU = @16-237C(Y)	0-35 kV, 24" Tan., (Y) = Wire Size



NOTES:
1. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 12" CLEARANCE TO ANY OTHER SPACER CABLE PHASE.
2. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16237	6/30/20

Supersedes 7/15 Issue – Updated drawing to 3D.

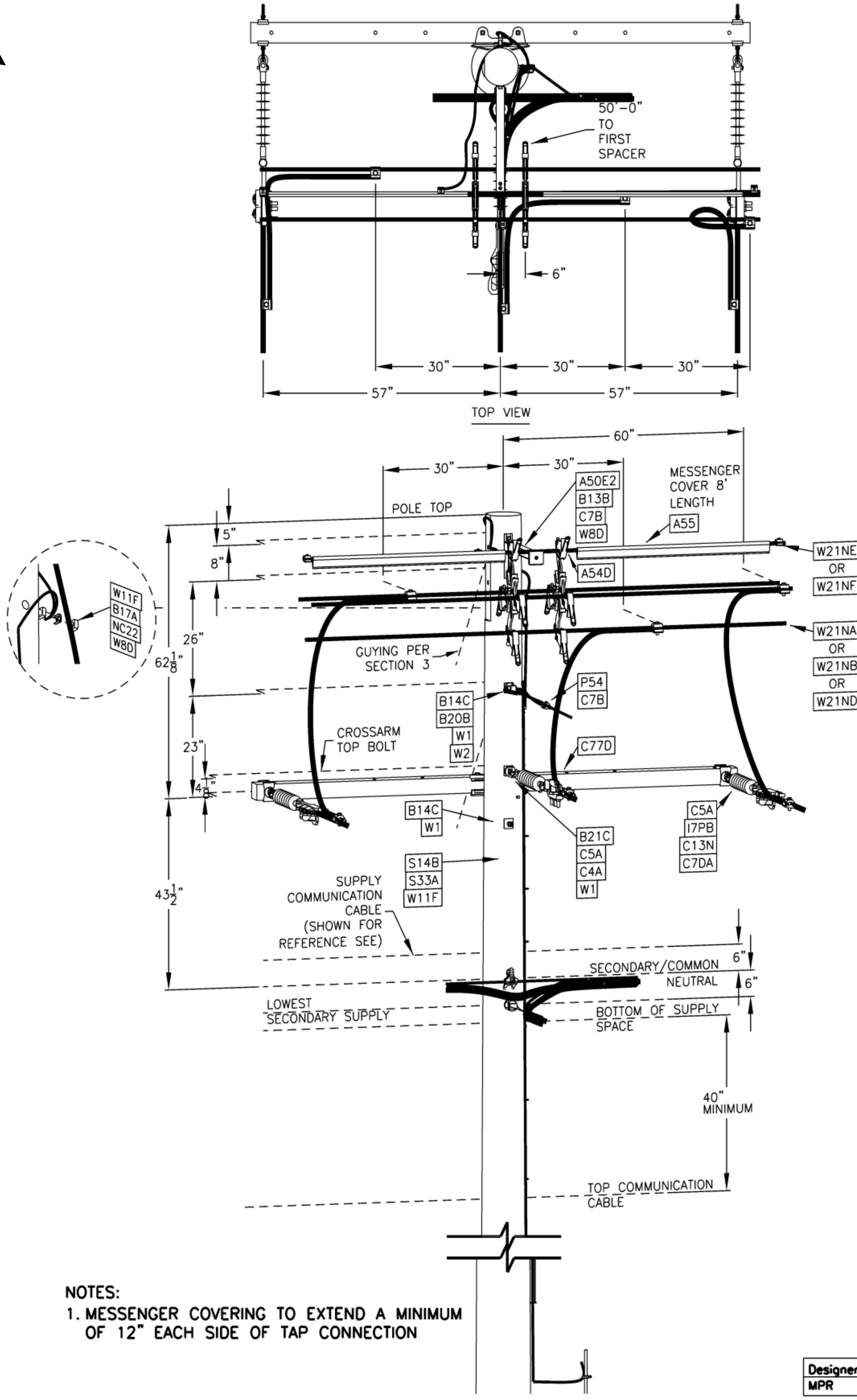
35KV LINE POLE ATTACHEMENT TO THREE PHASE OPEN WIRE TAP FOR 40' POLE WITH POLE TOP EXTENSION

ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD
7/20	16-237	

Business Use

MU = @16-240C(Y)	0-35 kV, 24" Tan., (Y) = Wire Size

Supersedes 7/15 Issue – Updated drawing to 3D.



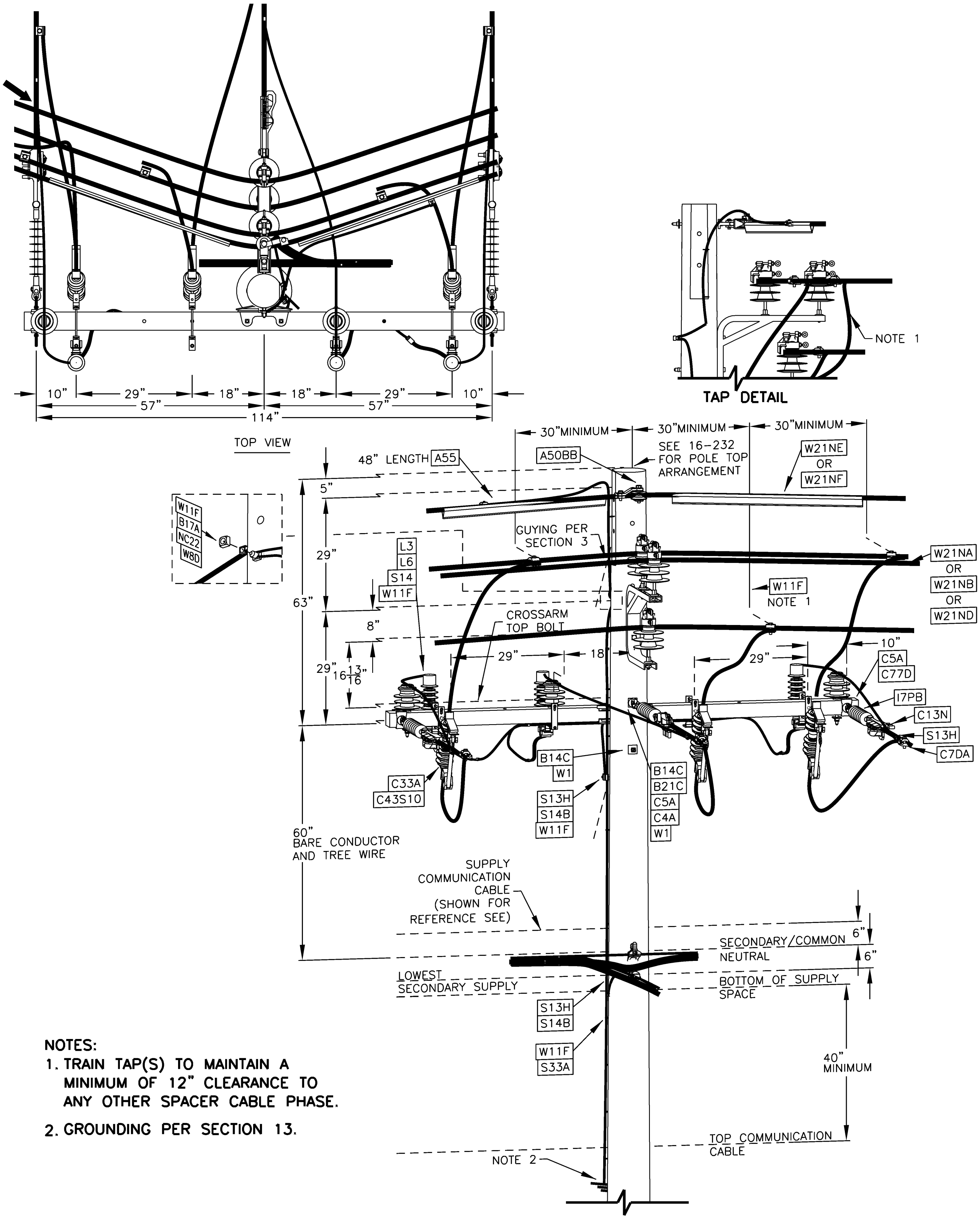
NOTES:
1. MESSENGER COVERING TO EXTEND A MINIMUM OF 12" EACH SIDE OF TAP CONNECTION

Designer	Drawing	Date
MPR	od16240	6/30/20

35KV LINE POLE ATTACHEMENT TO THREE PHASE SPACER CABLE TAP FOR 40' OR 45' POLE

	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
ppl		16-240	7/20

MU = @16-243C(Y)	0-35kV, E Brkt., (Y) = Wire Size	MU = @16-2432PHC(Y)	0-35 kV, E Brkt., 2 Ph. Jct., (Y) = Wire Size



NOTES:
1. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 12" CLEARANCE TO ANY OTHER SPACER CABLE PHASE.
2. GROUNDING PER SECTION 13.

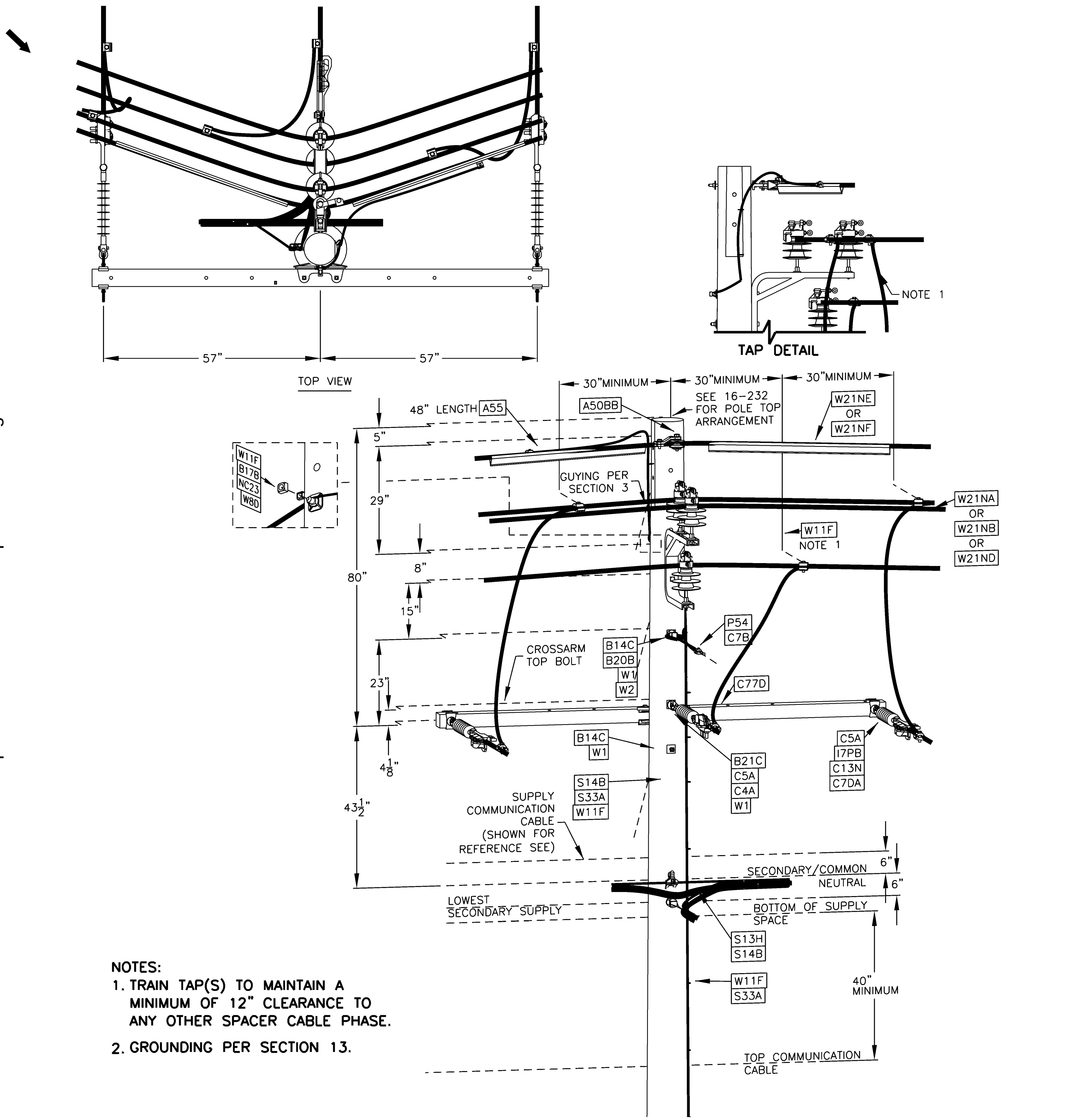
Designer	Drawing	Date
MPR	od16243	7/16/20

Supersedes 7/15 Issue – Updated drawing to 3D.

35KV CORNER POLE ATTACHMENT TO THREE PHASE OPEN WIRE TAP FOR 45’ POLE – LINE ANGLES 7° – 60°

ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	
7/20	16-243		

Supersedes 7/15 Issue – Updated drawing to 3D.



NOTES:

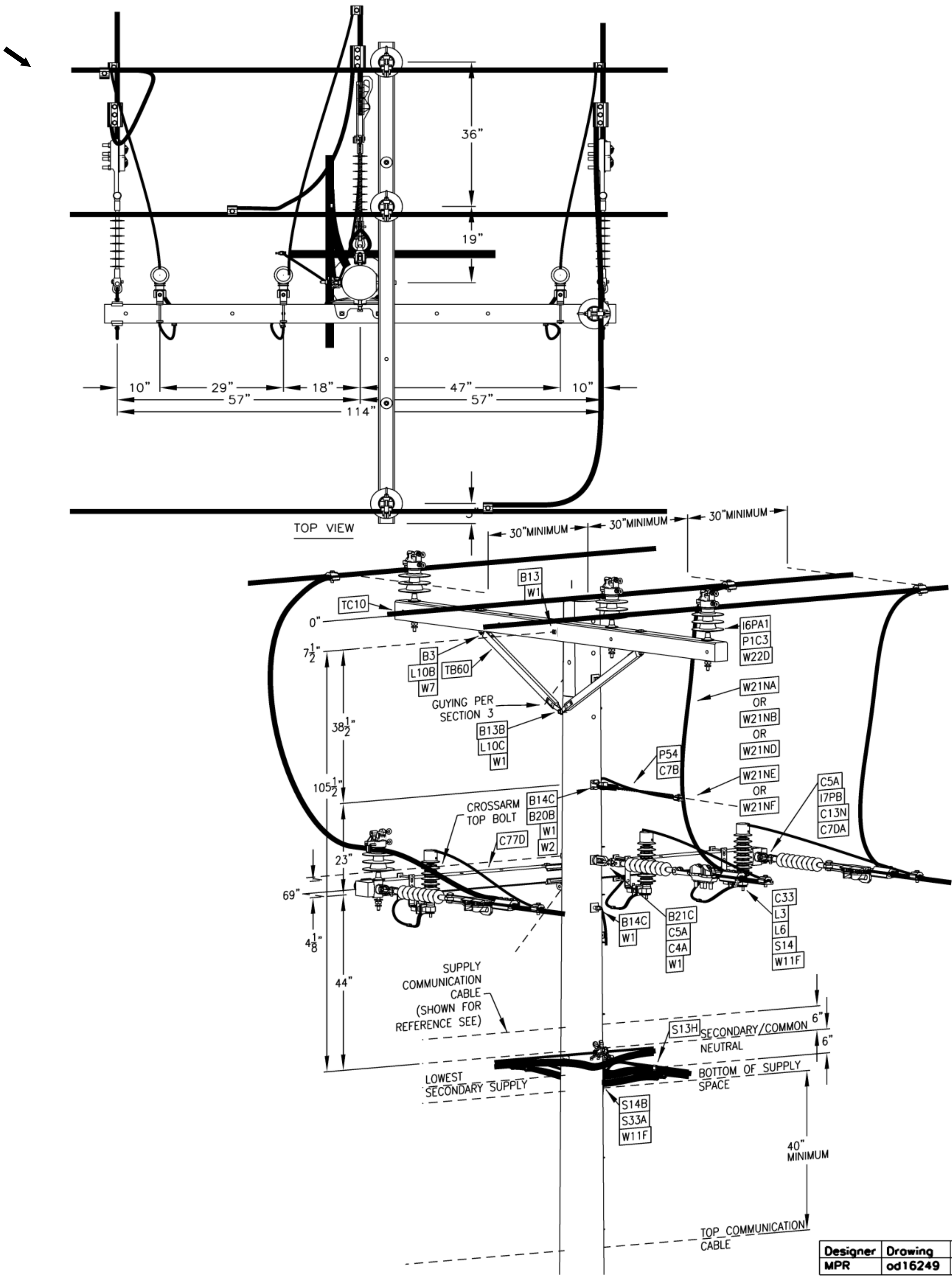
1. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 12" CLEARANCE TO ANY OTHER SPACER CABLE PHASE.
2. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16246	7/16/20

35KV CORNER POLE ATTACHMENT TO THREE PHASE SPACER CABLE TAP FOR 45’ POLE			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER: 16-246	ISSUE: 7/20

MU = @16-249C(Y)	0-35 kV, Crossarm, (Y) = Wire Size	MU = @16-249(X)C(Y)	0-35 kV, Crossarm, (X) = 11/21/46, (Y) = Wire Size

Supersedes 7/09 Issue - Updated drawing to 3D

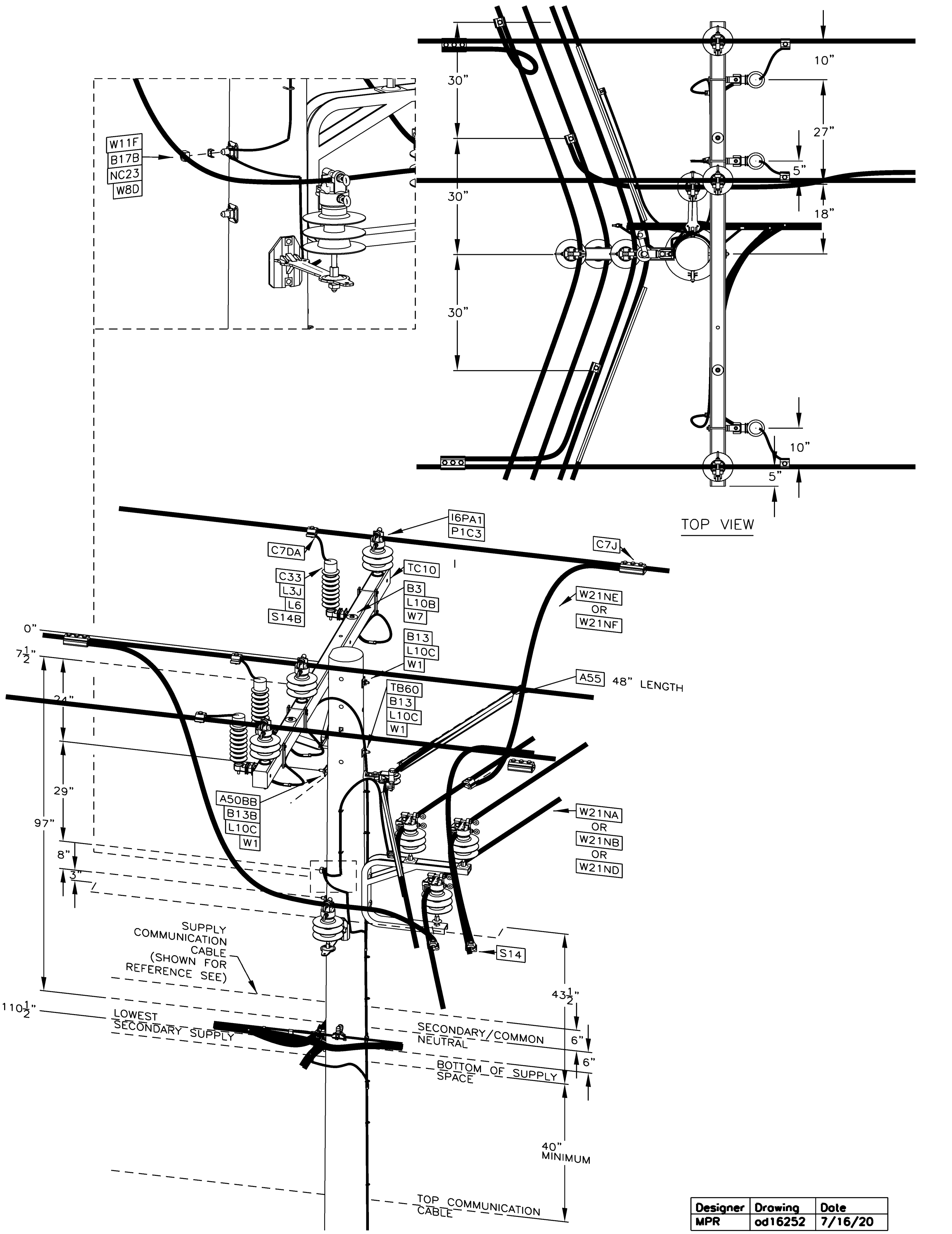


Designer	Drawing	Date
MPR	od16249	6/30/20

35KV OPEN WIRE STRAIGHT LINE TO THREE PHASE SPACER CABLE TAP

MU = @16-252C(Y)	0-35 kV, C Brkt., (Y) = Wire Size

Supersedes 7/15 Issue – Updated drawing to 3D

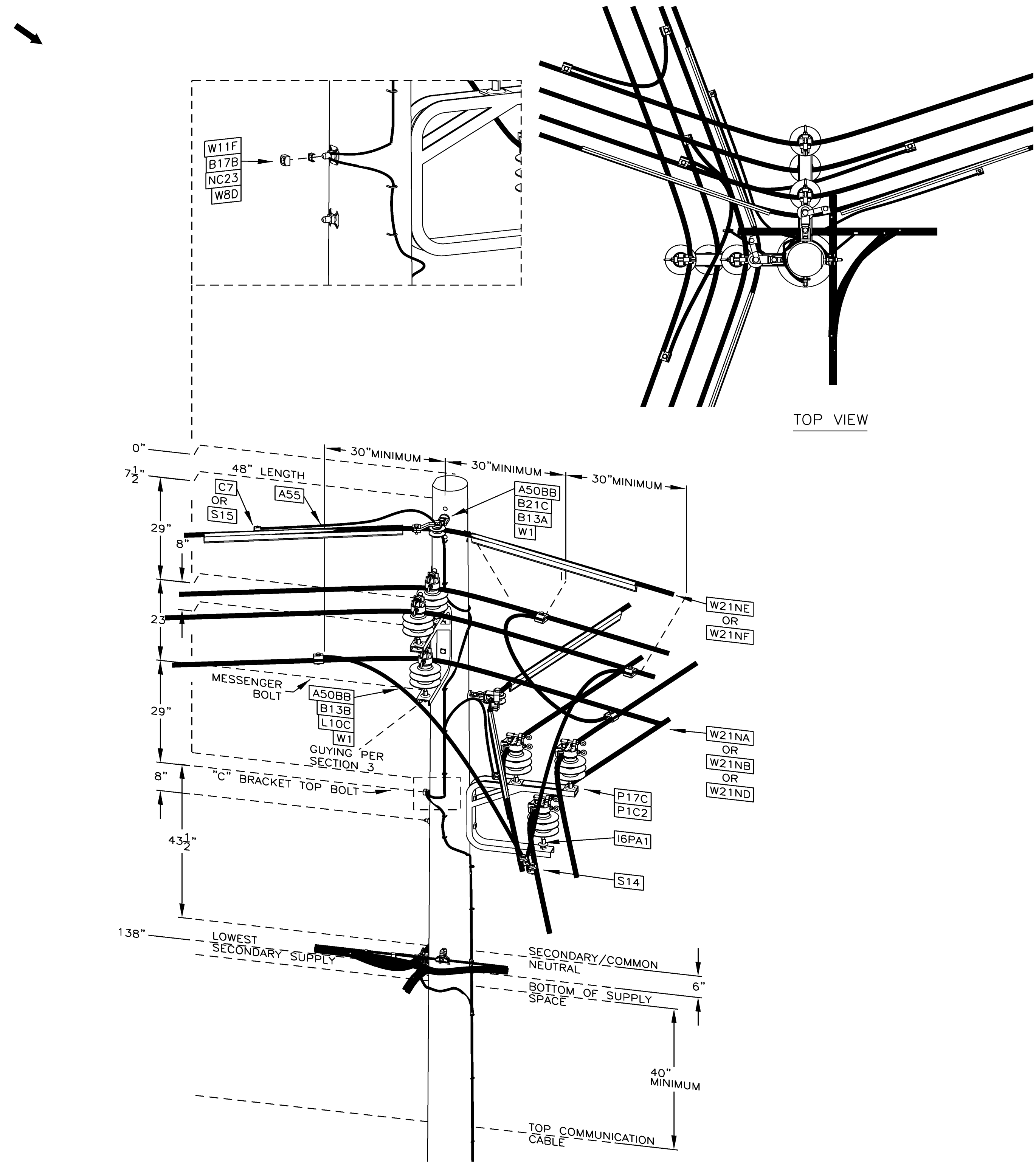


Designer	Drawing	Date
MPR	od16252	7/16/20

35KV FOUR WAY JUNCTION
CROSSARM CONSTRUCTION TO SPACER CABLE WITH 45' POLE

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	16-252	7/20

MU = @16-255C(Y)	0-35 kV, C Brkt., (Y) = Wire Size

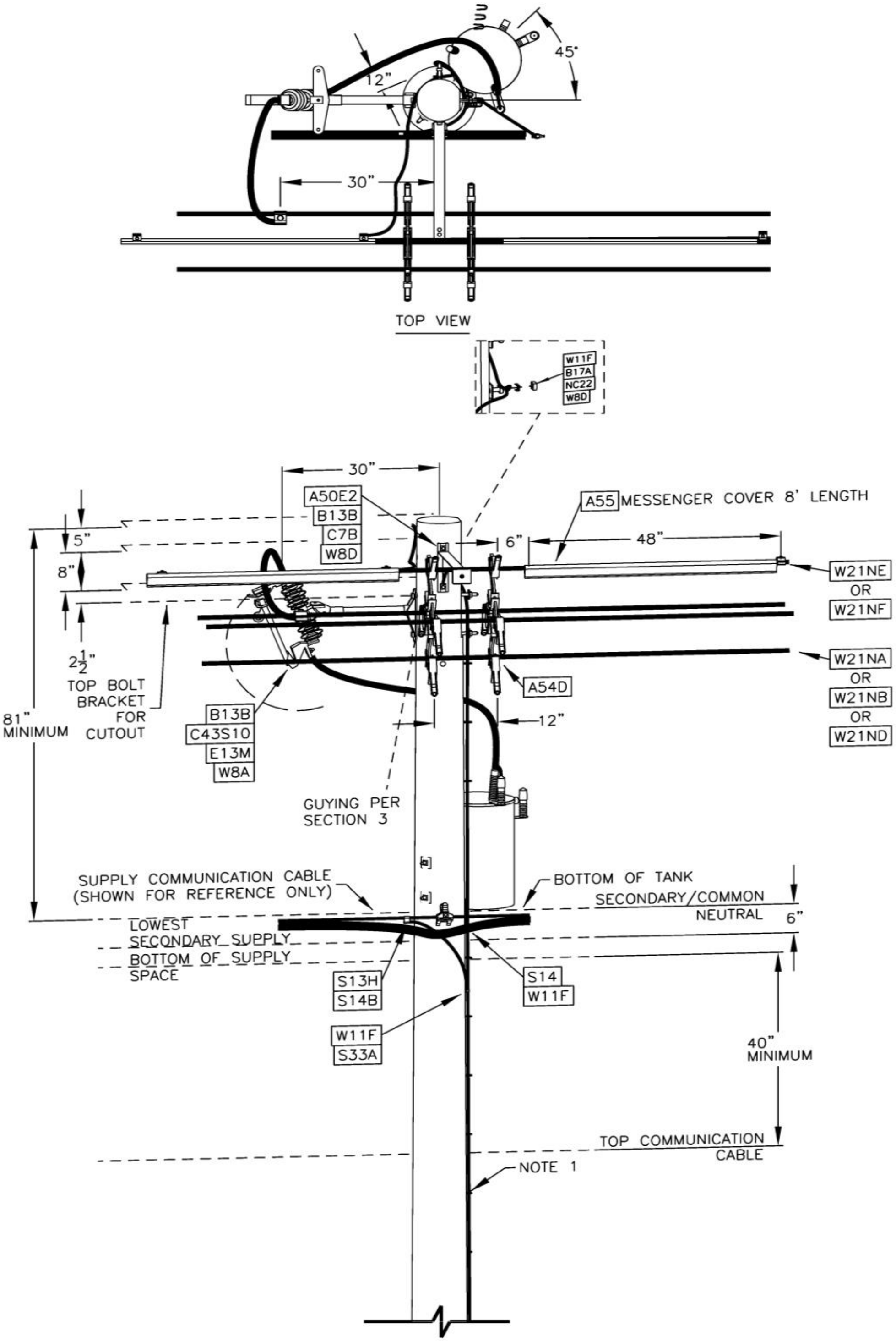


Supersedes 7/09 Issue - Updated drawing to 3D

Designer	Drawing	Date
MPR	od16255	7/16/20

35KV FOUR WAY JUNCTION – SPACER CABLE TO SPACER CABLE WITH 45' POLE

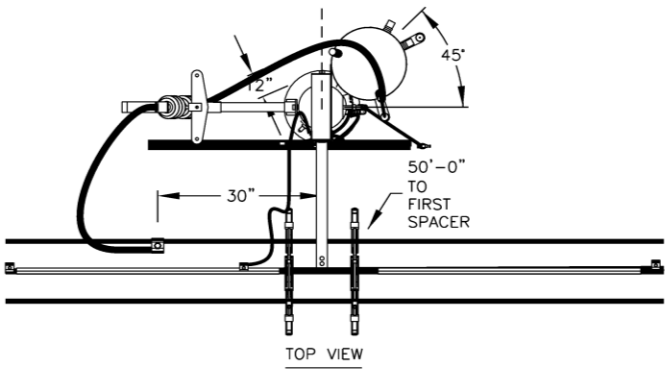
Supersedes 7/13 Issue – Updated drawing to 3D

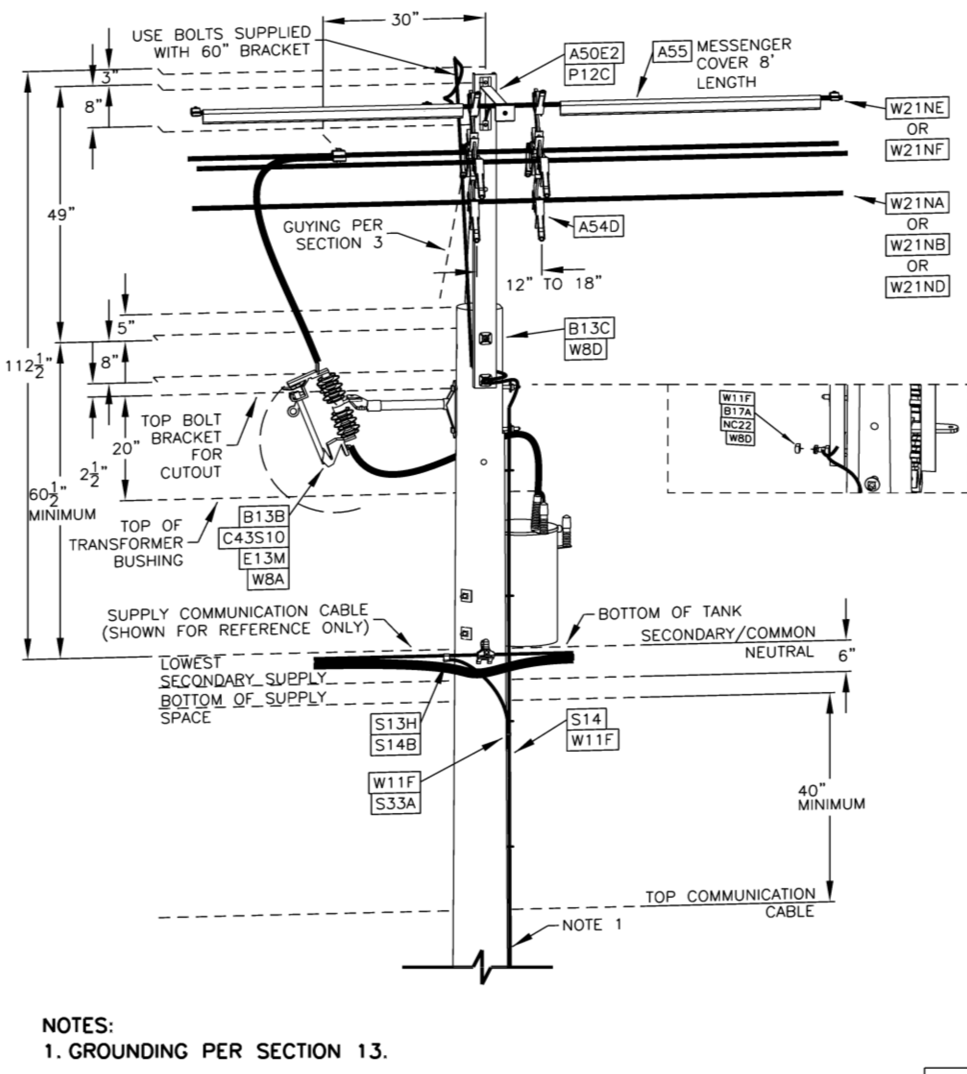


NOTES:
1. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16258	6/30/20

35KV TRANSFORMER INSTALLATION SINGLE PHASE FOR 40' OR 45' POLE			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 16-258	ISSUE 7/20





NOTES:

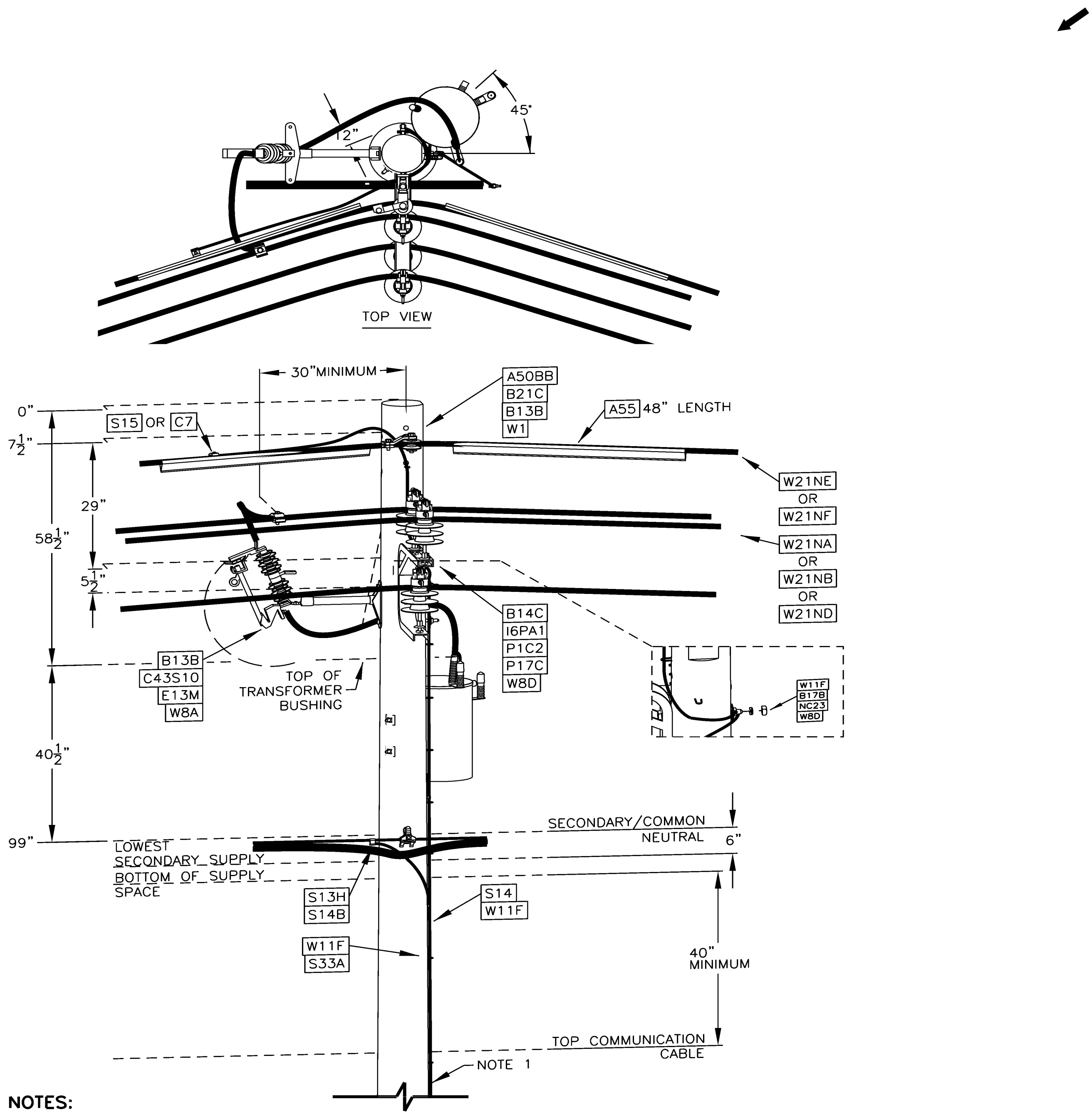
1. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16259	6/30/20

Supersedes 7/15 Issue – Updated drawing to 3D

35KV TRANSFORMER INSTALLATION SINGLE PHASE FOR 40' POLE WITH POLE TOP EXTENSION			
ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/15	16-259		

Supersedes 7/07 Issue – Updated drawing to 3D



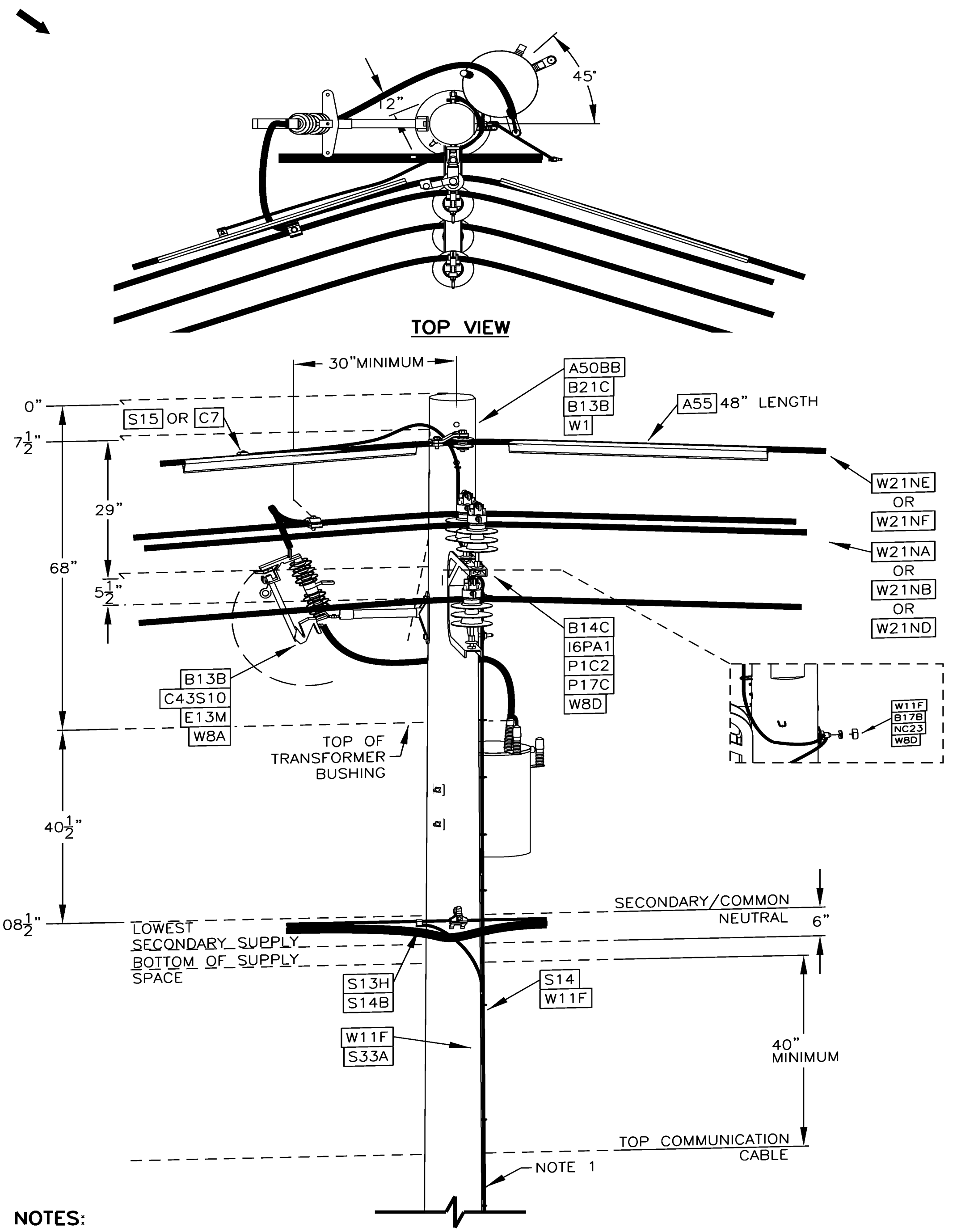
NOTES:

1. GROUNDING PER SECTION 13.

Designer	Drawing	Date
MPR	od16262	7/16/20

35KV TRANSFORMER INSTALLATION SINGLE PHASE
FOR 40' POLE – LINE ANGLES 7° – 60°

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	16-262	7/20



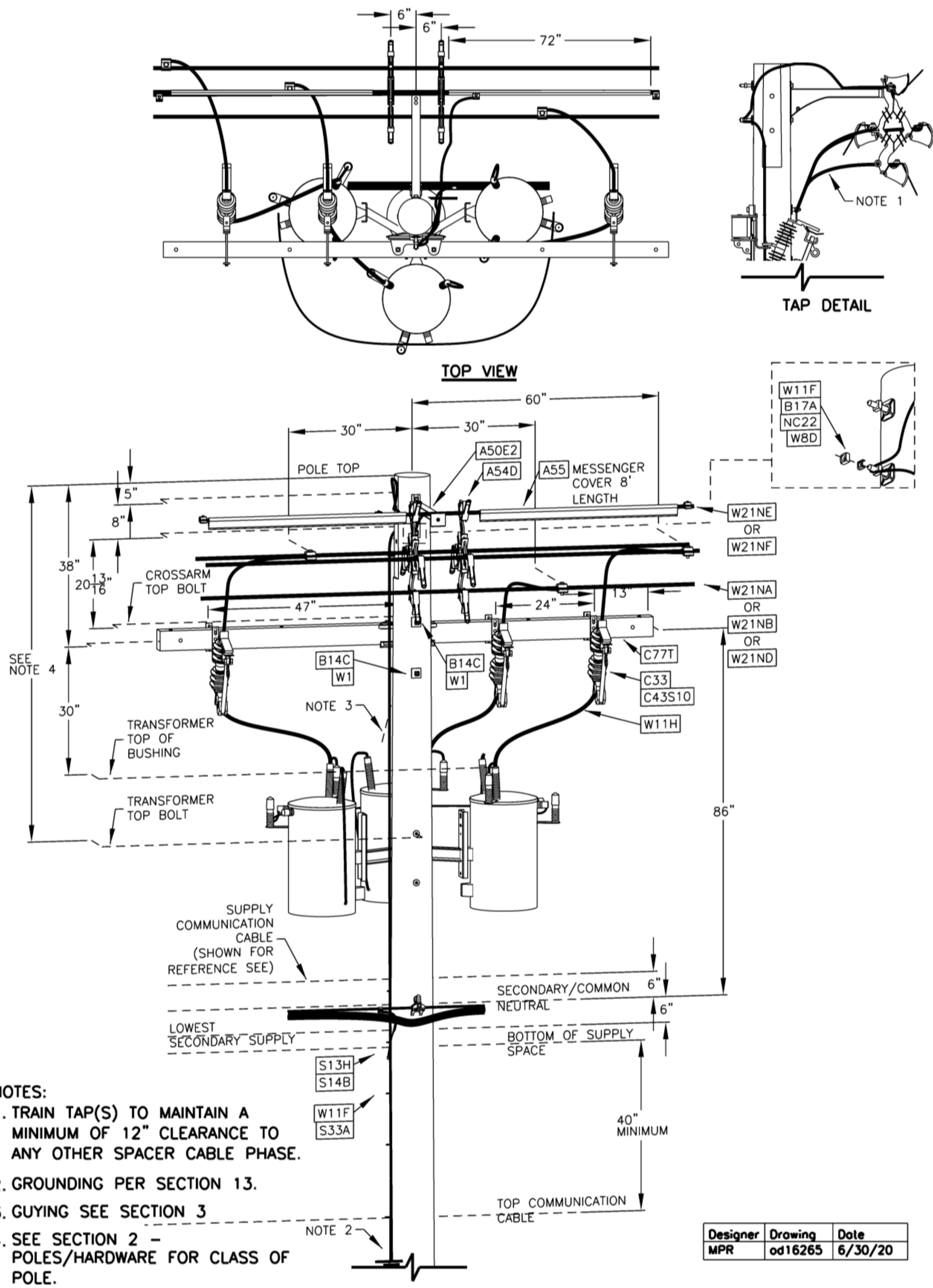
NOTES:
1. GROUNDING PER SECTION 13.

Supersedes 7/07 Issue – Updated drawing to 3D

Designer	Drawing	Date
MPR	od16263	7/16/20

35KV TRANSFORMER INSTALLATION SINGLE PHASE FOR 45' POLE – LINE ANGLES 7° – 60°			
ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/20	16-263		

Supersedes 7/18 Issue – Updated drawing to 3D



NOTES:

1. TRAIN TAP(S) TO MAINTAIN A MINIMUM OF 12" CLEARANCE TO ANY OTHER SPACER CABLE PHASE.
2. GROUNDING PER SECTION 13.
3. GUYING SEE SECTION 3
4. SEE SECTION 2 – POLES/HARDWARE FOR CLASS OF POLE.

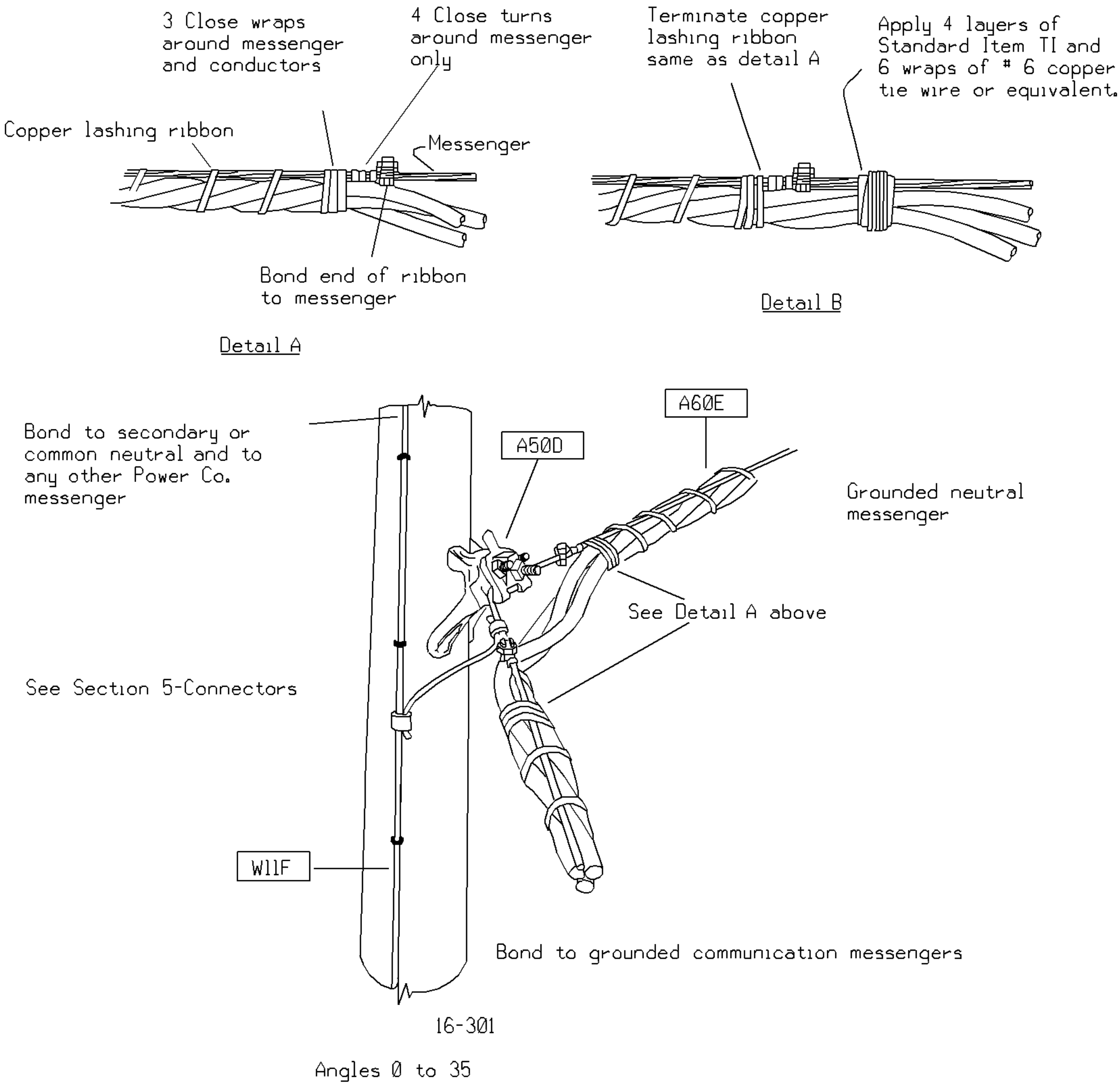
Designer	Drawing	Date
MPR	od16265	6/30/20

35KV TRANSFORMER INSTALLATION THREE PHASE BANK

	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
ppl		16-265	7/20

Aerial Cable Construction Drawings

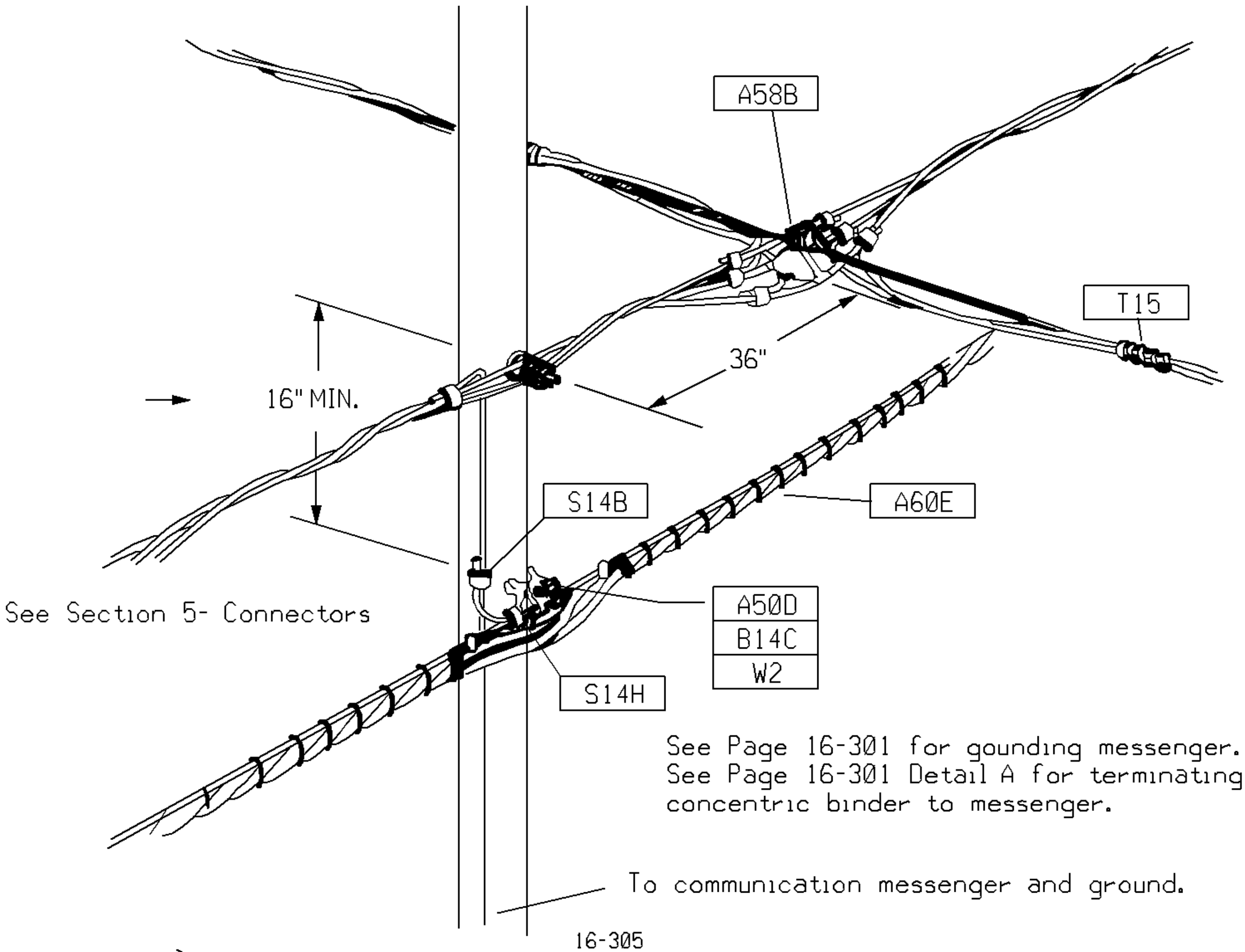
CU = PBSCHA
CU = PBSCA

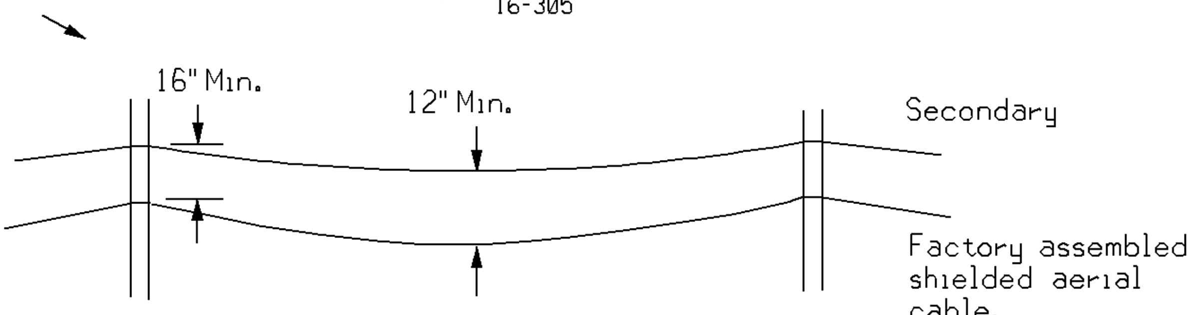


Supersedes 1/06 Issue – Revised Construction Detail

DETAILS OF ATTACHMENT, BONDING, AND TERMINATION OF CONCENTRIC BINDER TO NEUTRAL

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	16-301	7/07





Clearances

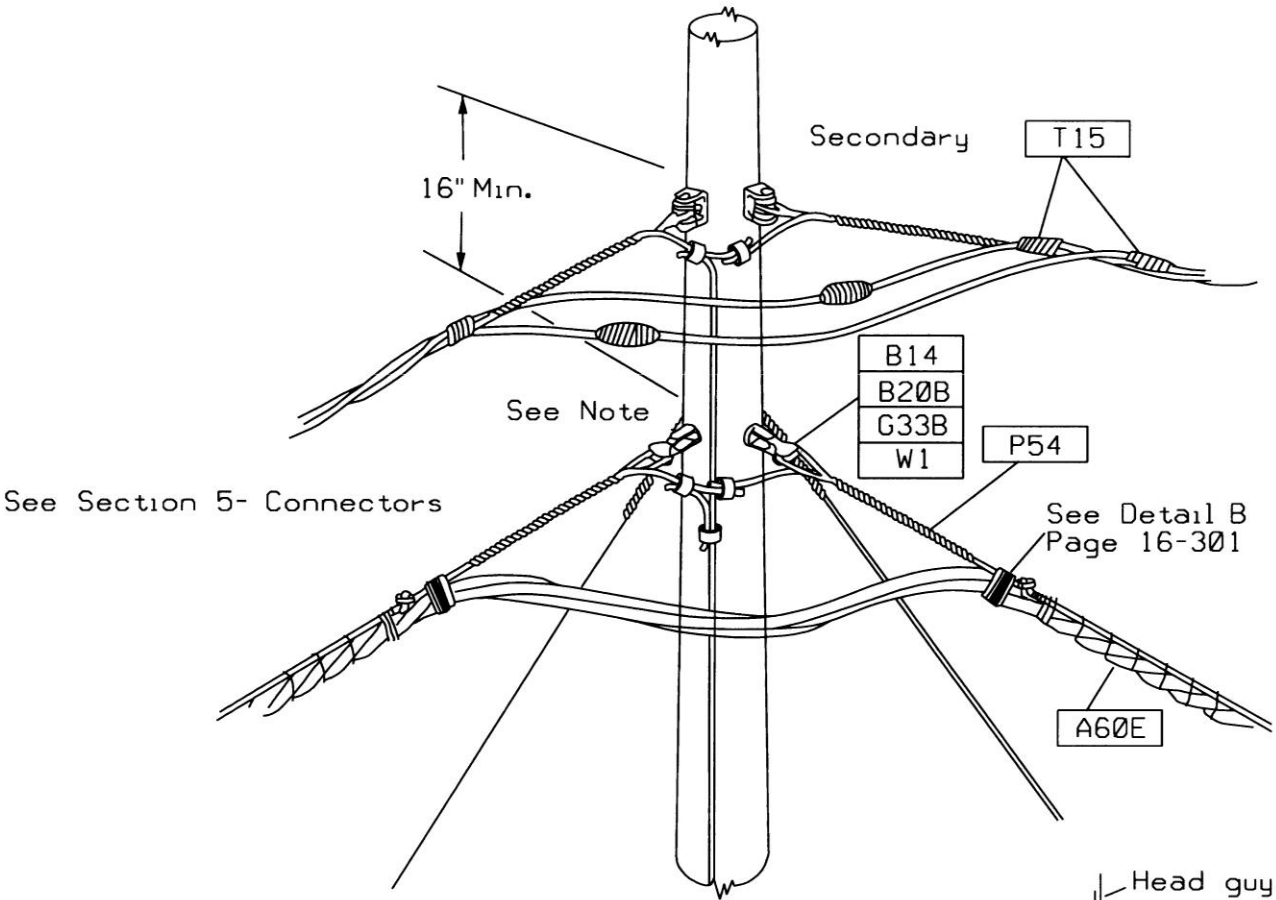
Supersedes 1/06 Issue – Revised Construction Detail

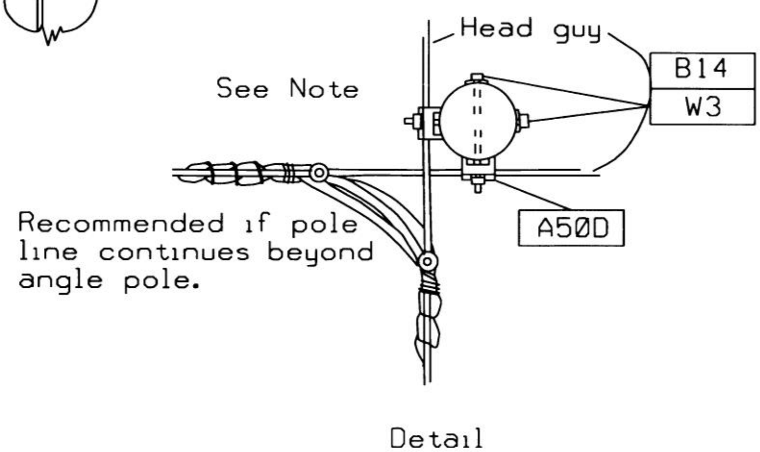
Notes:

1. Where factory assembled shielded aerial cable is installed, limit the midspan taps on secondary to those 3 ft. from the pole.

2 Bond the messenger of the factory assembled shielded aerial cable to the secondary or common neutral at each transformer, at ends of each secondary, and elsewhere to provide a bond on every fourth pole.

MU = @16-310WDE	30º-90º, With DE	MU = @16-310ALT	30º-90º, With A50D





Supersedes 7/08 Issue - Updated MU.

Note:

2 guys are required if L/H is less than 60% (75% at a R.R. crossing). Log anchor may also be required. It is preferable to install head guys to lower point on adjacent pole as per detail A, or one head guy and one anchor guy.

15KV ANGLES 36° – 90° & DEAD ENDS

MU = @16-315

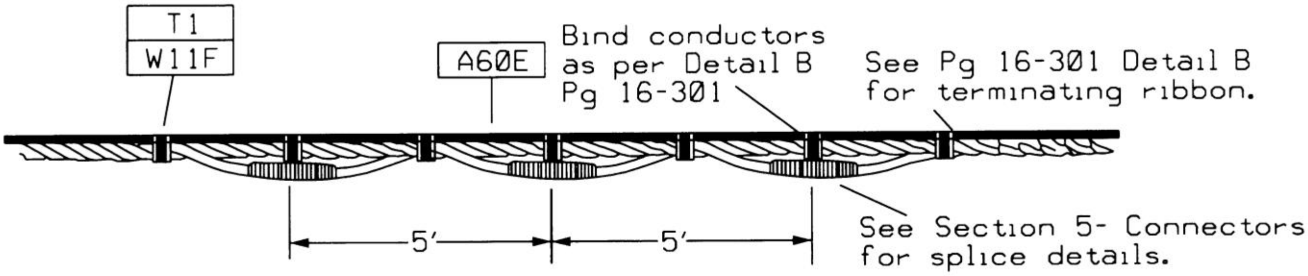
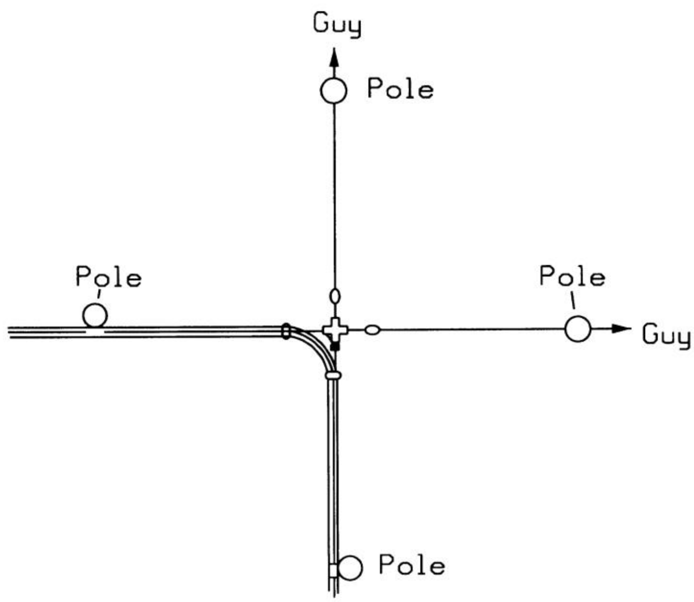


Fig. I



Plan

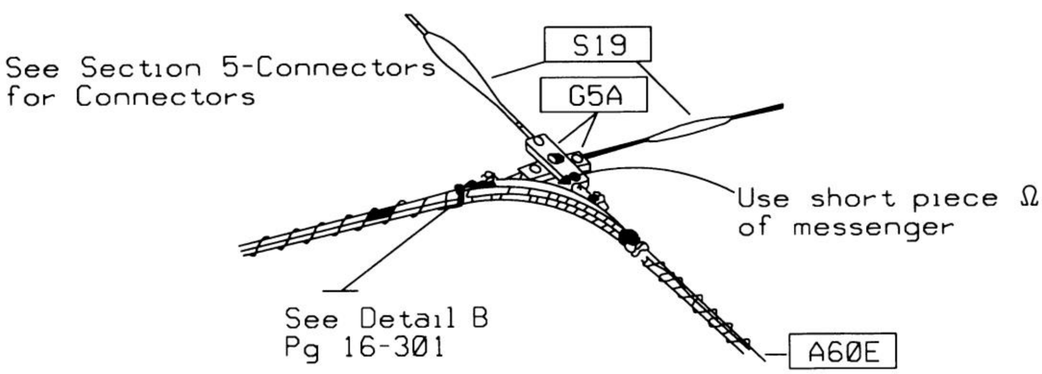
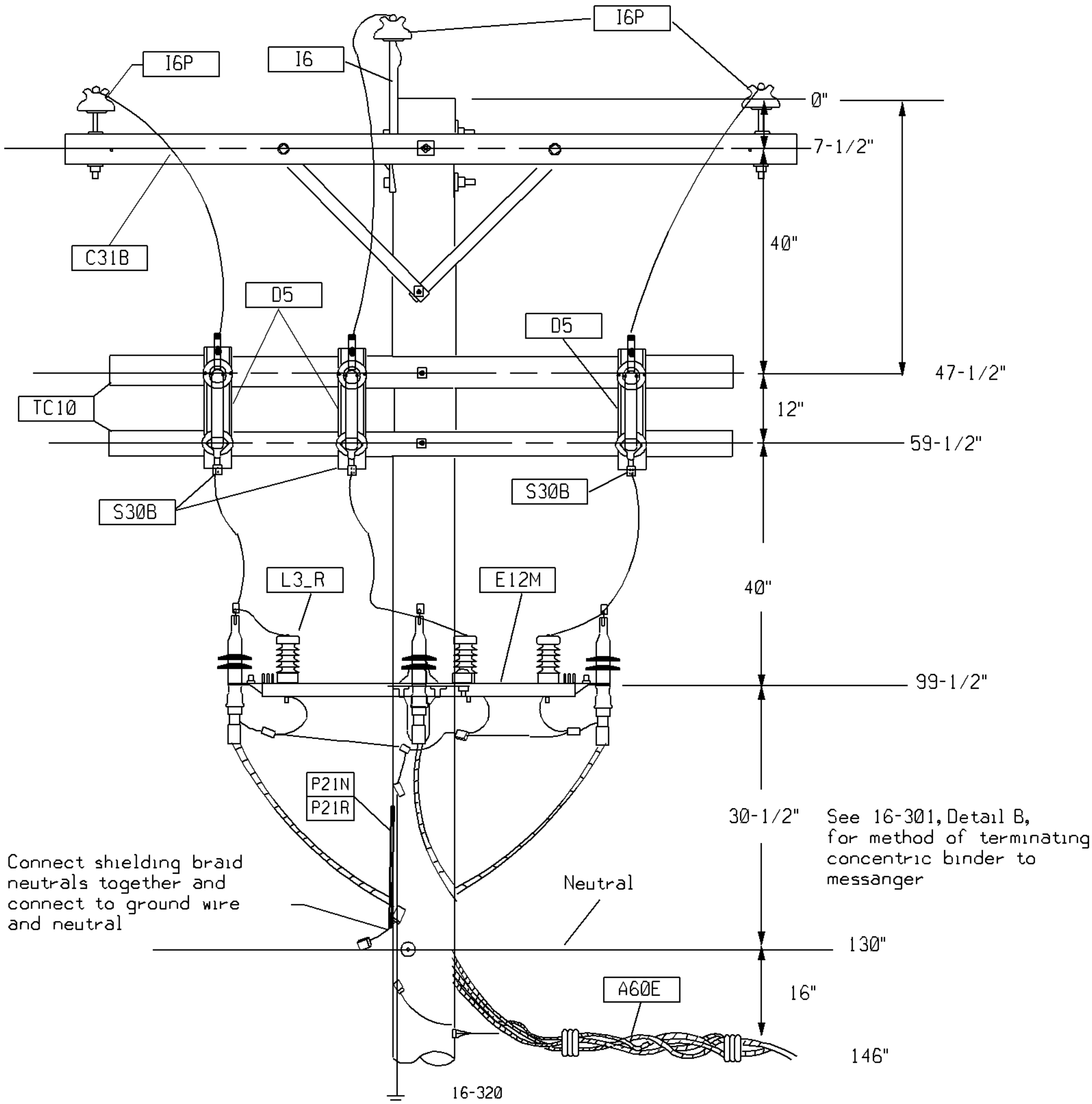


Fig. II

Supersedes 1/06 Issue – Revised Construction Detail

<table>
<tr><td colspan="4">15KV STRAIGHT SPLICE AND MID-SPAN CORNER DETAILS</td></tr>
<tr><td>ISSUE</td><td>PAGE NUMBER</td><td rowspan="2">OVERHEAD
CONSTRUCTION STANDARD</td><td rowspan="2">ppl</td></tr>
<tr><td>7/07</td><td>16-315</td></tr>
</table>

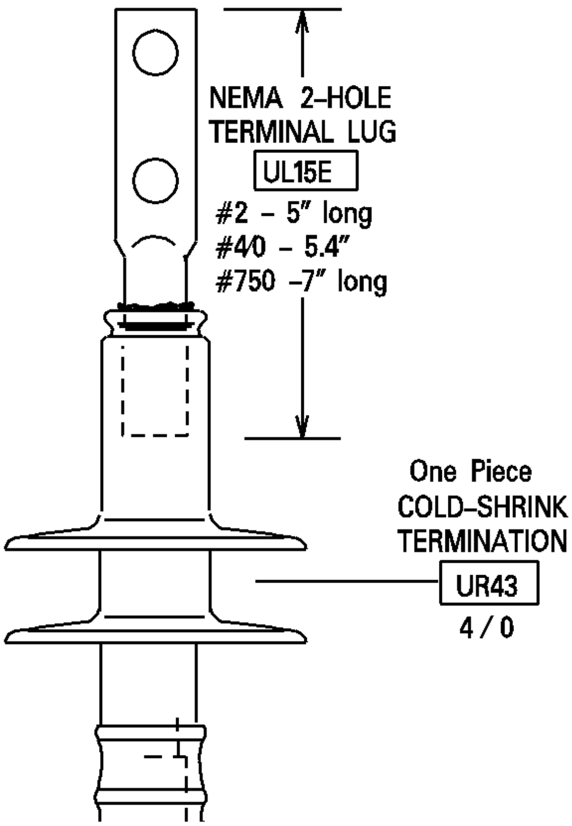
Supersedes 1/06 Issue – Revised Construction Detail

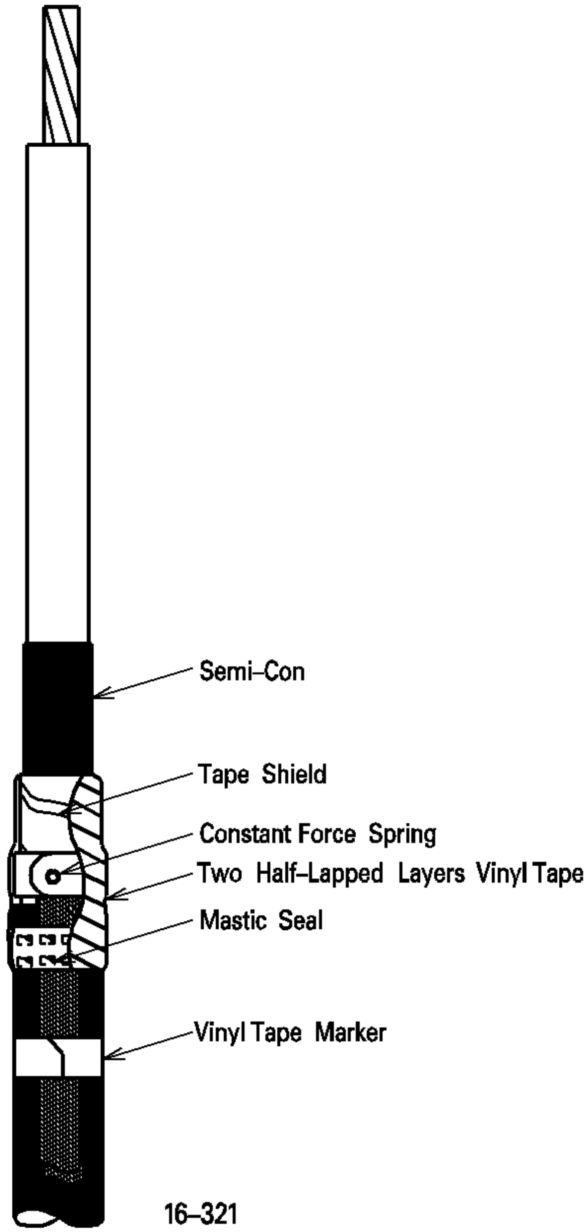


Notes:

1. Secondary can be accommodated on this pole. The preferred arrangement is to avoid secondary.
2. See Section 18 - Risers for lightning arrester and disconnect switch connection assemblies as well as for equipment mount and equipment mount adapter assembly.
3. See Section 5 - Connectors for outdoor taped cable termination details and for premolded modular cable termination details.
4. Switch identification mounted vertically on road side providing maximum visibility.

15KV PREASSEMBLED LASHED AERIAL CABLE TO OPEN WIRE





REQUIRED MATERIALS:

- 3M Cold-Shrink Termination Kit UR44C
- Black Friction tape T1A
- Black Vinyl electrical tape T2W
- Terminating connector UL15E
- Copper-braid grounding tape T1T5 (shielded cable (PLAC) only)
- Grounding connector S14
- Cable Identif.tag UP21 (if required)

Cold-Shrink Terminations are recommended for the Outdoor termination of Insulated and shielded standard cables. Properly installed terminations will provide the required electrical stress relief and resistance to water and moisture ingress. Some taping may be required where cold-shrink termination does not cover terminal connector barrel.

NOTES:

- Avoid knife damage to the conductor strands and the insulation layers.
- Determine required cable length by training the cable into its final proposed position before cutting.
- ALL traces of removed SemiConductive layer MUST be removed from the underlying insulation layer to prevent tracking and termination failure.

New Construction Drawing Illustrating PLAC Cold Shrink Termination Detail

Version	Date	Modification	Author(s)	Approval by (Name/Title)
10	7/21	• Updated item ID from C33A to C33 in pages 16-126 thru 16-173.		
9	7/20	• Updated pages 16-10 through 16-14 to include SAP Item ID numbers • Updated page 16-16, Gel Wrap Method • Updated pages 16-47 through 16-51, Aerial Cable Preparation and Splicing		
8	7/18	• Added connector standard item ID to Section 16.3.20 I7 on page 16-7. • Replaced wood crossarm with fiberglass crossarm for cutout mounting in drawings 16-171, 16-173, and 16-265		
7	7/15	• Added 16.6.20 new cold shrink splice to aerial cable • Renumbered pages 16-47 through 16-58 • Added grounding clip detail to all bracket drawings. • Added messenger clamp A50BB to drawings 16-106, 16-107, 16-108, 16-148, 16-150, 16-151, 16-153, 16-157, 16-158, 16-160, 16-161, 16-168, 16-169, 16-173, 16-213, 16-232, 16-233, 16-243, 16-246.		
6	7/13	• Revised text in 16-47, Section 16.6 • Revised Description on page 16-153 and index page 16-ii. • Revised Drawing on page 16-220 • Revised Description in Title block on pages 16-258 &16-259.		
5	7/12	• Revised sag/tension tables for all spacer cables to reflect revised application of “k” factor for spacer cable in 2012 NESC. • Updated spacer cable ampacity ratings. • Revised Pg 16.47, Sect. 16.6 to include multiple aerial cable sizes.		
4	7/11	• Amended explanation of how to properly cover tap leads on spacer cable (16.20.I.6)		
3	7/10	• Corrected STD Id’s for spacer cable, and/or arrester/cutout tap wire and connectors on pages 16-101, 16-102, 16-103, 16-106, 16-107, 16-108, 16-109, 16-114, 16-115, 16-131, 16-134, 16-135, 16-138, 16-139, 16-143, 16-148, 16-151, 16-153, 16-155, 16-157, 16-158, 16-160, 16-161, 16-163. • Revised sag/tension and conductor prop		

		tables on Pages 16-55 and 16-56		
2	7/09	• Revised CUs/MUs on pages 16-101, 16-102, 16-103, 16-106, 16-107, 16-108, 16-109, 16-114, 16-115, 16-118, 16-122, 16-123, 16-126, 16-127, 16-131, 16-134, 16-135, 16-138, 16-139, 16-142, 16-146, 16-148, 16-150, 16-153, 16-155, 16-157, 16-158, 16-160, 16-161, 16-163, 16-201, 16-205, 16-206, 16-210, 16-213, 16-214, 16-217, 16-220, 16-223, 16-226, 16-228, 16-232, 16-233, 16-236, 16-237, 16-240, 16-243, 16-246, 16-249, 16-252, 16-255, 16-310. • Revised drawing details on pages 16-138, 16-139, 16-148, and 16-163.		
1	7/08	• Revised Dimensional Details and added notes on pages 16-101, 16-102, 16-103, 16-106, 16-107, 16-108, 16-109, 16-114, 16-126, 16-127, 16-131, 16-134, 16-135, 16-138, 16-139, 16-160, 16-163. • Updated Std. Item Identifiers on page 16-123. • Rev dimensional detail on pages 16-142, 16-143, 16-146, 16-148, 16-150, 16-151, 16-153, 16-155, 16-157, 16-158, 16-161, 16-165, 16-168, 16-169, 16-171, 16-173.		

Supersedes 7/16 Issue – Added Smart City and Electric Vehicle Drawings.

New Issue – Added Smart City and Electric Vehicle Drawings.

Supersedes 1/06 Issue – Text change.

17.0. GENERAL

This Standard covers the engineering practices for application of poles used jointly by the Company's electric supply facilities, communications company facilities and other facilities.

If two or more entities must install overhead lines on the same street, it is usually in the public interest to install them on joint use poles. On the Company's system, the terms for this joint use are covered by agreements between the joint users. This Section covers the special requirements for such poles.

Depending on the geographic location of the poles, reference should be made to Electric System Bulletin #101, the applicable Joint Use or Joint Ownership Agreement, the applicable Administrative and Operating Procedures (AOPs) or Intercompany Operating Procedures (IOPs), and applicable Distribution Pole Attachment or Aerial License Agreements for details of ownership, division of costs, division of work responsibilities, rental or licensing fees, and other detailed terms and conditions.

17.1. POLES

17.1.10 General

Contact should be made with the telephone and CATV companies serving the area, to determine their requirement or possible short-term future need for pole space, before poles are installed. Poles should be installed to provide space for foreign or joint use only when there is an agreement with another entity to share use of the pole, in which the other entity agrees to rent or license space on the pole(s) or purchase an ownership interest in the pole(s).

The Company shall not accept the cost of added space without compensation, even when the costs are low. Future plans should be based on the Company needs only, unless there are written commitments from others to rent or license space or to purchase an ownership interest.

After each entity has identified its need for space, new poles shall be selected from the Allocated Space Tables located on Pages 17-100 and 17-101. Joint poles or poles with extra height should be used depending on how these poles meet needs for clearance of all the users that have agreed to rent or license space or to purchase an ownership interest.

The necessity of replacing jointly owned poles shall be mutually agreed on by the joint owners, in writing, in each specific case. Neither joint owner shall at any time change the location of or remove any jointly owned pole without the written consent of the other party.

17.1.20 Pole Strength

The class of pole (pole strength) can be determined from the calculations and Tables in Section 3-Guying for storm guys and Section 2-Poles/Hardware.

This calculation will need the cooperation of the communication facility owner(s) to determine present and future wind loads under heavy loading conditions.

As an alternate practice to installing stronger poles, the line may be guyed for transverse load every second or third pole.

17.2 GUYS

Each entity shall provide guys of sufficient strength to hold the unbalanced load of its own wires and attachments (See Section 3-Guying).

Joint anchors and rods shall be used whenever practical and in any case Distribution Design shall arrange the exact location of each anchor. Triple thimble eyes are the standard anchor rod eye nuts.

17.3 CLIMBING SPACE

Adequate clearances for climbing shall be provided as shown on Page 7-127. Care shall be taken when installing services, street lights, risers, etc. so that full climbing space is available to line workers from all attaching entities.

17.4 CLEARANCES

Clearances between communication space and electric supply space attachments are shown on Page 17-102. Reference should also be made to Section 7-Clearances.

Communications messengers in the communication space shall have a vertical spacing of 12 inches (center-to-center) at the pole. To avoid a pole replacement, provided other NESC requirements are satisfied and the new attacher, adjacent attachers and the joint pole owner agree, PPL will allow a reduction in vertical spacing between communication messengers to not less than 6 inches at the pole. If the spacing of 12 inches at the pole between communication messengers can be achieved without pole replacement, then the spacing of 12 inches shall be maintained. Communications conductors, cables and equipment of one communication utility to those of another shall have at least 4" clearance (surface-to-surface) anywhere in the span.

17.5 LOCATION OF ATTACHMENTS

Cooperative effort is needed to avoid placing heavy communication equipment on power company poles with cable risers or equipment that will make climbing difficult. The appearance of individual poles and the whole pole line should also be considered.

Communication equipment, such as CATV, power supplies, telephone air dryers, telephone stands, etc., shall be installed on joint poles in accordance with Pages 17-105 thru 17-108 or special drawings approved by Standards Engineering.

In general, avoid placing risers for multiple entities on one pole. When this is not practical, install them per Section 18-Risers as well as Section 48-Risers of the Underground Construction Standards manual.

17.6 15kV MAXIMUM DISTRIBUTION WOOD POLE MOUNTED METERED POWER SUPPLY AND ANTENNA INSTALLATIONS

17.6.10 Application

This Section covers installation details for distribution wood pole mounted, metered, secondary service to power supplies and antenna communication equipment on poles with 15kV maximum voltage equipment on pole.

17.6.20 General

All installations shall be made in compliance with all applicable codes including the National Electrical Safety Code (NESC) and National Electrical Code (NEC), with local wiring inspector requirements and with applicable service requirements from the Company's tariffs and "Specifications for Electrical Installations" (ESB 750) book. The communication entity shall contact the Company office serving the area involved and also obtain agreement from all other affected pole occupants and/or owners. The communication entity shall submit all appropriate documentation in a timely fashion to allow for necessary engineering and construction to take place.

17.6.30 Location

Poles selected for communication mounted equipment shall be relatively "clean" poles, free of any other major equipment, and accessible by bucket truck throughout the year. Antennas shall <u>not</u> be installed on poles with airbreak or loadbreak switches, line reclosers, sectionalizers, capacitors, voltage regulators, transformers, primary or secondary risers, major communications or fire alarm equipment, other antennas, three or four-way primary junction poles and backyard poles.

Supersedes 7/15 Issue – Limited antenna installations to poles with 15kV maximum voltage equipment on pole in Section 17.6.10.

Supersedes 1/06 Issue – Limited antenna installations to poles with 15kV maximum voltage equipment on pole in Section 17.6.40(I).

17.6.40 Division of Responsibility

A.) A rain tight weatherhead shall be mounted in a location suitable for the Company to form a driploop and to make secondary connections (See Pages 17-108 thru 17-109).

B.) Service entrance cables shall be #10 stranded copper, insulated THWN, THHN, or SE conductor suitable for outdoor use. The cable shall include two black insulated conductors and one white insulated conductor and shall extend a minimum of 24 inches beyond the weatherhead to form a driploop and to make secondary connections.

C.) Electric service conduit shall be 1inch PVC schedule 40, at a minimum, sunlight and weather resistant as well as direct and weather sealed to the meter socket enclosure. Conduit straps shall be placed at intervals not exceeding 30 inches.

D.) An approved meter socket shall be installed on the quarter of the pole away from vehicular traffic. The meter shall be a ringless socket sealable style with a safety arc shield and an approved single handle-operation bypass; use of an automatic bypass is not permitted. The meter socket shall be approved by an Authority of Higher Jurisdiction (AHJ) accepted organization concerned with product evaluation and carry the label of that agency.

E.) Bracket system, (Std. Item C39E or equivalent), for mounting the socket to the pole (See Page 17-107). Attach the bracket to the pole with galvanized lag screws and the socket to the bracket with stainless steel bolts, nuts and lock washers. In the event that a 120/208 V meter is installed, a 5th terminal is required.

F.) Disconnect and overcurrent protection shall be limited to a 30 A maximum service rating and should be located in a separate compartment from the meter socket.

G.) Grounding shall consist of #4 covered, soft drawn copper down ground (Std. Item W11F), and copper or bronze connectors, and copperclad 5/8 inch diameter x 8 foot length ground rod(s). An additional ground rod shall be installed if it is necessary to lower the resistance to earth. All equipment shall be bonded to the grounding system. The communication company shall leave enough grounding conductor coiled at the location of the weatherhead for final connection by the electric company to their aerial ground wire/system neutral conductor. This ground arrangement shall apply unless local requirements specify otherwise.

H.) A single power supply shall be located on the back side of the pole away from vehicular traffic with a maximum weight not to exceed 670 lbs. All mounting equipment shall be galvanized steel construction.

I.) If needed, an antenna shall be mounted via an approved method at the top of the distribution pole. The antenna maximum weight shall not exceed 110 lbs. and the maximum height shall be 104 inches including any mounting hardware. The minimum horizontal clearances between the antenna and any primary energized part up to 15kV shall be 12".

J.) If needed, a cable shall be directly routed from the antenna to the power supply inside a 2 inch PVC conduit that is schedule 40 minimum as well as sunlight and weather resistant.

K.) If needed, fiber shall be directly routed from the power supply to the splice box inside a 2 inch PVC riser guard that is schedule 40 minimum as well as sunlight and weather resistant.

Following the municipal wiring inspector's approval of the construction by others, the Company shall provide all connections to the secondary supply conductors including the communication company's grounding conductor. The Company will also set the meter with a polycarbonate cover.

Note: All work performed in or above the "Communication Worker Safety Zone" shall be completed by an electrically qualified worker meeting NESC and OSHA requirements. Further detail can be referenced in ESB #750 or the Electric Service Information and Requirements documents.

17.7 ALL-DIELECTRIC FIBER OPTIC (ADFO) CABLE IN THE SUPPLY SPACE

17.7.10 General

This fiber section covers the installation of all-dielectric fiber optic (ADFO) communication cables in the supply space of distribution poles with supply line voltages of 34.5 kV or less. ADFO communication cables may be installed in the supply space of distribution poles only by attachers having an agreement allowing such attachments made prior to January 1, 2010.

The Company allows the installation of ADFO communication cables in the supply space of distribution poles. Such installations must comply with the requirements detailed below, with the NESC and with any applicable federal, state or local regulations.

Under the NESC, a communication cable may be installed in the supply space; however, such a cable is considered part of the supply space. This means that the Communication Worker Safety Zone requirements between this communications cable in the supply space and communication space attachments apply when a separate communication space is required on the pole. This also means that workers installing and maintaining this cable in the supply space must meet the more stringent worker training and equipment requirements for work in the supply space. These requirements come from the NESC and OSHA, as well as by state and local regulations.

17.7.20 Approved Installation

Per Company requirements, ADFO cable is the only type of fiber cables that may be installed in the supply space. An ADFO cable is entirely dielectric including being supported on a messenger that is entirely dielectric. The key distinguishing feature of this type of cable is that the entire cable assembly is dielectric. A cable assembly that contains any metallic component cannot be considered all-dielectric.

The other type of fiber cable, an effectively grounded cable, is a communication cable that is supported on a messenger and is effectively grounded throughout its length. In general, the Company shall not allow the installation of any communication cables with a metallic component in the supply space even if that cable is effectively grounded.

17.7.30 Location on Pole

The Company will designate the location on each pole for any communication cables installed in the supply space. In general, this cable shall be the next cable above the existing neutral or secondary cable. Where there are multiple communication cables in the supply space, to the extent practical, this location should be in the same relative position on adjacent poles.

Supersedes 7/07 Issue – Limit ADFO attachments to agreements made prior to January 1, 2010.

In general, an ADFO cable must be attached to the pole with a 12 inch minimum separation in any direction from the electric neutral or secondary cables and at least 30 inches of separation from any primary electric supply cable or other energized part (See pages 17-110 thru 17-118). A 12 inch vertical separation between the ADFO cable and the electric neutral or secondary cables at the pole is preferred. Where this is not possible, the owner of the communication cable may install an ADFO cable on an offset bracket to obtain a 12 inch minimum horizontal separation from the neutral or secondary cable. The bracket should be installed immediately above the neutral or secondary cable. Grounding of this bracket is not required.

17.7.40 Clearances

The NESC imposes no minimum clearance requirement between an ADFO cable and some classes of cables in the supply space. In particular, the NESC does not specify clearances between an ADFO cable in the supply space and any other cable in the supply space up to and including, the 15 kV class. The NESC also does not specify clearances between an ADFO cable and supply cables in the 23 kV or 34.5 kV classes where the cables are owned by the same entity. However, the NESC does specify clearance requirements between an ADFO cable and supply cables in the 23 kV or 34.5 kV classes where the cables are owned by different entities.

Where the NESC does not specify clearances, maintaining the ability of all parties to safely work on their cables is still a primary concern. Therefore, ADFO cables shall be installed with a minimum 12 inch separation at the pole, in any direction, from the electric neutral or secondary cables. To allow work on the communication cable without requiring the Company to cover its primary electric supply cables or other exposed parts, an ADFO cable in the supply space shall be installed with a 30 inch minimum separation in any direction from any primary cable or other exposed part at the pole.

Where the NESC specifies clearances, at a minimum those clearances shall be followed. This type of installation may be approved by Distribution Design based on a review of the specific proposed installation. If a request for this type of installation is received, consult Standards Engineering for specific applicable requirements.

17.7.50 Sag and Tension

An ADFO cable installed in the supply space should be sagged to approximately match the sag of the existing secondary or neutral cable with both cables at final sag condition at 60°F/15°C. The communication cable's owner shall provide the Company with appropriate sag and tension data for the cable used. The owner of the communication cable is responsible for costs associated with the additional space required to accommodate cables that do not follow this recommended practice.

17.7.60 Worker Qualifications

The installation, maintenance, modification and removal of cables or equipment in the supply space must be done by workers qualified to work in that space. The owner of the communication cable shall ensure that the workers installing its fiber in the supply space understand and meet the requirements of the NESC (Part 4) and OSHA (Parts 1910 and 1926), and that various states and localities each impose requirements on employers for the training, qualification, equipment and practices of workers in the supply space. The Company expects that the owner of the communication cable will assure compliance with all applicable NESC, OSHA, state and local requirements by the workers installing the communication cable(s) in the supply space and their employer.

Supersedes 1/06 Issue – Repaging.

17.8 WOOD DISTRIBUTION POLE MOUNTED SECURITY AND SURVEILLANCE CAMERAS

17.8.10 General

This Section covers installation details for wood distribution pole mounted security and surveillance cameras.

All third party use of PPL poles will be authorized by written agreement. Occupancy fees are routinely assessed for use of PPL facilities (e.g., poles), however, such fees may be waved for municipal or law enforcement short term (temporary) installations. Unless waived by PPL Security or Business Services, permanent installations including those of municipalities and law enforcement agencies are subject of occupancy fees. In addition to occupancy fees, the applicant (requestor) shall reimburse PPL for support services (e.g. field surveys, make ready work, etc.) and energy supply costs for such installations. Energy cost shall be per Company tariffs. Municipal franchise agreements and/or pole permits should be reviewed to determine municipal rights regarding use of Company facilities. Unless otherwise noted below, PPL's Telecommunication Attachment Department shall hold all Agreements, retain and invoice for appropriate occupancy and support service fees. Energy cost shall be managed and invoiced through Business Services.

NOTE: Many poles are jointly owned with the Telephone Company. PPL cannot unilaterally authorize use of joint owned poles, e.g., application must also be made to and authorization received from our joint pole owner.

17.8.20 Location on Pole

The security and surveillance cameras shall be installed at least 12 inches below the lowest communication cable.

17.8.30 Division of Responsibility

A.) A rain tight weatherhead shall be mounted in a location suitable for the Company to form a driploop and to make secondary connections (See Page 17-118).

B.) Service entrance cables shall be #10 stranded copper, insulated THWN, THHN, or SE conductor suitable for outdoor use. The cable shall include two black insulated conductors and one white insulated conductor and shall extend a minimum of 24 inches beyond the weatherhead to form a driploop and to make secondary connections.

C.) Electric service conduit shall be 1inch PVC schedule 40, at a minimum, sunlight and weather resistant as well as direct and weather sealed to the meter socket enclosure. Conduit straps shall not be placed at intervals exceeding 30 inches.

D.) An approved meter socket shall be installed on the quarter of the pole away from vehicular traffic. The meter shall be a ringless socket sealable style with a safety arc shield and an approved single handle-operation bypass; use of an automatic bypass is not permitted. The meter socket shall be approved by an Authority of Higher Jurisdiction (AHJ) accepted organization concerned with product evaluation and carry the label of that agency.

E.) Bracket system, (Std. Item C39E or equivalent), for mounting the socket to the pole (See Page 17-107). Attach the bracket to the pole with galvanized lag screws and the socket to the bracket with stainless steel bolts, nuts and lock washers. In the event that a 120/208 V meter is installed, a 5th terminal is required.

New construction standard for pole mounted security and surveillance cameras.

F.) Disconnect and overcurrent protection shall be limited to a 30 A maximum service rating and may be located in a separate compartment from the meter socket.

G.) Grounding shall consist of #4 covered, soft drawn copper down ground (Std. Item W11F), and copper or bronze connectors, and copperclad 5/8 inch diameter x 8 foot length ground rod(s). An additional ground rod shall be installed if it is necessary to lower the resistance to earth. All equipment shall be bonded to the grounding system. The owner of the Security or Surveillance camera shall leave enough grounding conductor coiled at the location of the weatherhead for final connection by the electric company to their aerial ground wire/system neutral conductor. This ground arrangement shall apply unless local requirements specify otherwise.

H.) A single power supply shall be located on the back side of the pole away from vehicular traffic with a maximum weight not to exceed 670 lbs. All mounting equipment shall be galvanized steel construction.

17.8.40 <u>Law Enforcement Requests For Criminal or Investigational Surveillance</u>

The Company supports all efforts related to national security (homeland security) and Law enforcement investigations. All such requests shall be directed to PPL Corporate Security. Due to confidentiality requirement of these requests, Corporate Security will be responsible arranging PPL support services and for maintaining all records associated with law enforcement requests and the subsequent installation of these technical surveillance devices.

17.8.50 <u>Other Municipal Requests</u>

The Company supports municipal public service efforts (e.g. traffic control, building/parking lot security, etc.). Consistent with existing franchise agreements and PPL operational needs, PPL will authorize municipal camera installations. All such requests shall be directed to Business Services.

RHODE ISLAND						
Pole Length (Feet)	Ownership Percentage (Elec./Tel.)	Normal Setting Depth (Ft-Inches)	Tel. Space Allocation (Ft-Inches)	Licensee Space Allocation (Ft-Inches)	Municipal Space Allocation (Ft–Inches)	Electric Space Allocation (Ft-Inches)
35	35/35	6’-0”	2’-6”	1’-0”	1’-0”	60”
40	40/40	6’-0”	2’-6”	1’-0”	1’-0”	78”
45	45/45	6’-6”	2’-6”	1’-0”	1’-0”	105”
50	50/50	7’-0”	2’-6”	1’-0”	1’-0”	132”
55	55/55	7’-6”	2’-6”	1’-0”	1’-0”	159”
60	60/60	8’-0”	2’-6”	1’-0”	1’-0”	186”

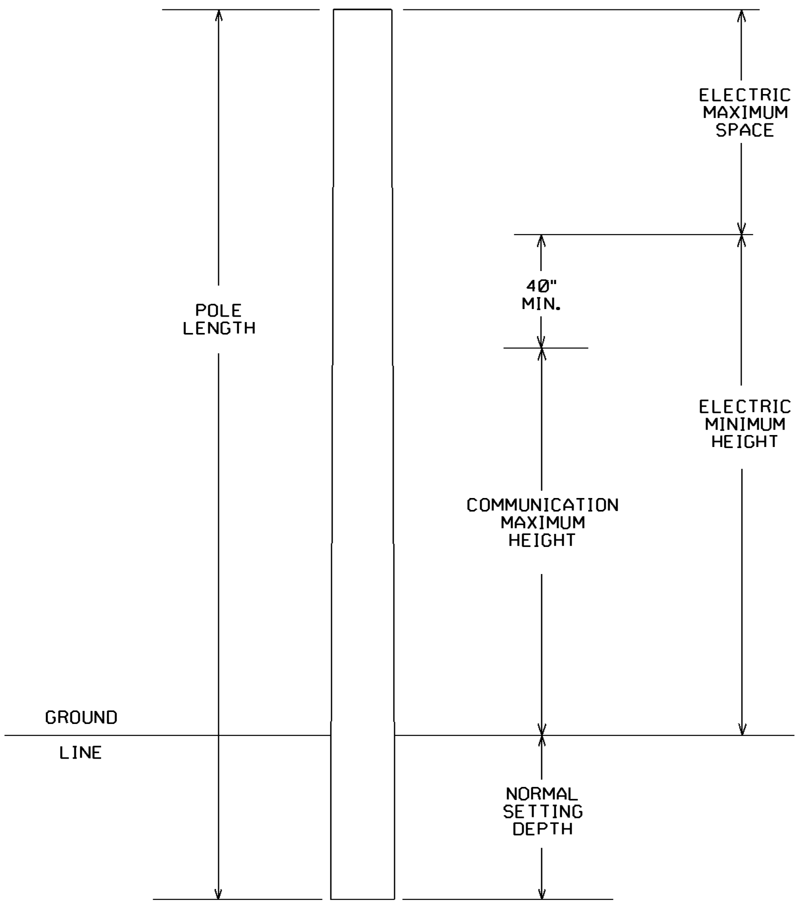
See notes on page 17-100A and diagram on page 17-101.

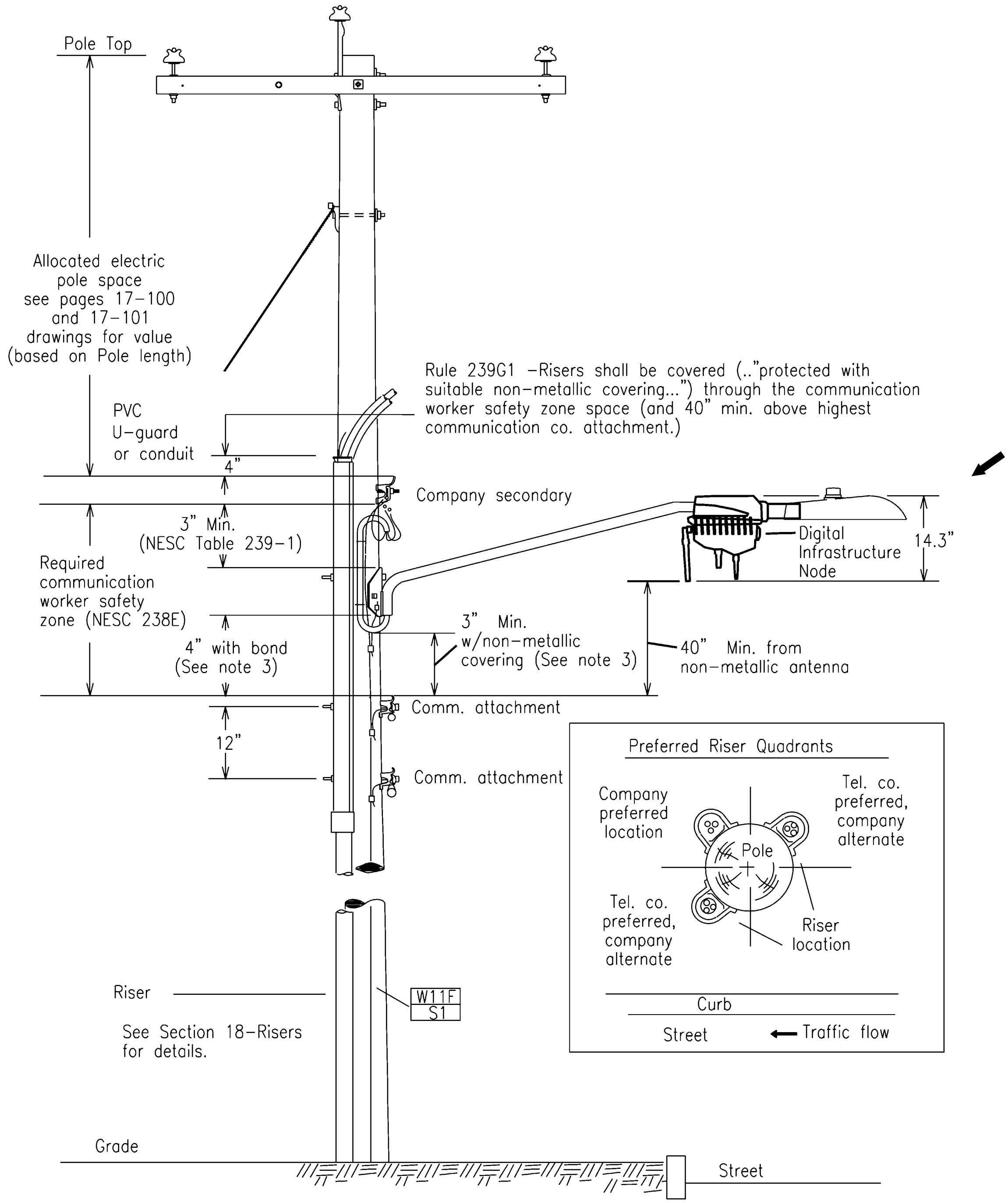
NOTES:

1. 45/40 indicates a 45 foot pole where the communication company pays for and occupies the space as if it were a 40 foot joint pole. 40/45 indicates a 45 foot pole where the Company pays for and occupies the space as if it were a 40 foot joint pole.
2. These space allocations are based on wood poles with embedment depths of 2 ft plus 10% of the pole length. Space allocation may need to be adjusted when other embedment depths are used, Not used in this edition.
3. Electric Maximum Space does not include 8” at the top of the pole that is considered unusable. Electric Minimum Height reflects Electric Maximum Space and the 8” unusable pole top.
4. To minimize pole replacements each party shall rearrange its attachments on existing poles to provide space for the other party, within the limits of each company’s construction standards, regardless of allocated space shown.
5. Generally, to meet in-span ground clearance requirements, communication companies must install their cables on the pole at least 18 feet above ground. If the communication cable can be installed on the pole at less than 18 feet above ground clearance (for example, 15 feet required in rear lots), the extra pole space is divided equally between the joint owners 1-½ feet to each. If ground clearance forces telephone companies upwards (say a 3 foot high knoll), each company may be required to give up equal space (1-½ feet) or use a 5 foot higher pole.

Supersedes 7/19 Issue – Revised the Rhode Island Space Allocation Table to reflect the current agreement between PPL and Versizon for these jurisdictions.

JOINT POLE SPACE ALLOCATION





Supersedes 7/10 Issue – Added information on clearances for streetlight bracket mounted communication equipment.

Notes:

1. Related NESC References:

   - Preferred Levels: Supply conductors should be carried at the higher level. (NESC Rule 220B1).
   - Vertical runs of supply conductors shall have a clearance of 2" from communication messengers, cables, attachment bolts and hardware, except ground wires may have a clearance of 1" from messengers, cables, attachment bolts and hardware. (NESC Rule 239G5).

- Within 8' of the ground, all vertical conductors and cables shall be appropriately guarded. Supply conductors shall be in metallic conduits and ground wires shall be guarded using ground wire molding. (NESC Rule 239D).

2. Minimum Attachment Heights: See Section 7 – Clearances for information about clearances above ground and minimum attachment heights.

3. Outdoor Lighting and Communications:

- For new pole installations and new streetlight installations on existing poles:
  - Streetlight brackets shall be bonded to the secondary or system neutral and drip loops shall be covered with non-metallic flexible conduit.
  - Vertical clearance between the grounded streetlight bracket and the communication messengers, cables, attachment bolts or hardware shall be at least 4".
  - Vertical clearance between the drip loop, covered with non-metallic flexible conduit, and the communication messengers, cables, attachment bolts or hardware shall be at least 3".

- For new communication facilities on or after February 1, 2017 on existing poles:
  - If the streetlight bracket is not bonded to the secondary or system neutral, maintain 40" vertical clearance between the streetlight bracket and the communication messengers, cables, attachment bolts and hardware. If the streetlight bracket is bonded to the system neutral, vertical clearance between the streetlight bracket and the communication messengers, cables, attachment bolts or hardware may be reduced to 4".
  - If the drip loop is not covered with non-metallic flexible conduit, maintain 12" vertical clearance between the drip loop and the communication messengers, cables, attachment bolts and hardware. If the drip loop is covered with non-metallic flexible conduit, vertical clearance between the drip loop and the communication messengers, cables, attachment bolts or hardware may be reduced to 3".

- For existing communication facilities installed prior to February 1, 2017 on existing poles:
  - If the streetlight bracket is not bonded to the secondary or system neutral, maintain 20" vertical clearance between the streetlight bracket and the communication messengers, cables, attachment bolts and hardware. If the streetlight bracket is bonded to the system neutral, vertical clearance between the streetlight bracket and the communication messengers, cables, attachment bolts or hardware may be reduced to 4".
  - If the drip loop is not covered with non-metallic flexible conduit, maintain 12" vertical clearance between the drip loop and the communication messengers, cables, attachment bolts and hardware. If the drip loop is covered with non-metallic flexible conduit, vertical clearance between the drip loop and the communication messengers, cables, attachment bolts or hardware may be reduced to 3".

- Streetlights should be mounted in the Communication Worker Safety Zone (CWSZ) between the supply and communication spaces on the pole. Streetlights may be mounted between communication messengers and cables only where streetlights mounted in the CWSZ cannot provide adequate illumination. When such installations must be made:
  - The streetlight bracket shall be grounded and the vertical clearance between the grounded streetlight bracket and the communication messengers, cables, attachment bolts or hardware above and below the streetlight shall be at least 4".
  - The drip loop shall be covered with non-metallic flexible conduit and the vertical clearance between the covered drip loop and the communication messengers, cables, attachment bolts or hardware shall be at least 3".
  - A CWSZ shall be established between (i) the communication attachment above the streetlight and (ii) the electric primary, neutral and secondary wires.

- See Section 19 – Lighting - OH for additional notes regarding outdoor lighting on joint use poles, including: bracket location and restraint and protection of supply conductors.

Supersedes 7/10 Issue – Updated Note 3.

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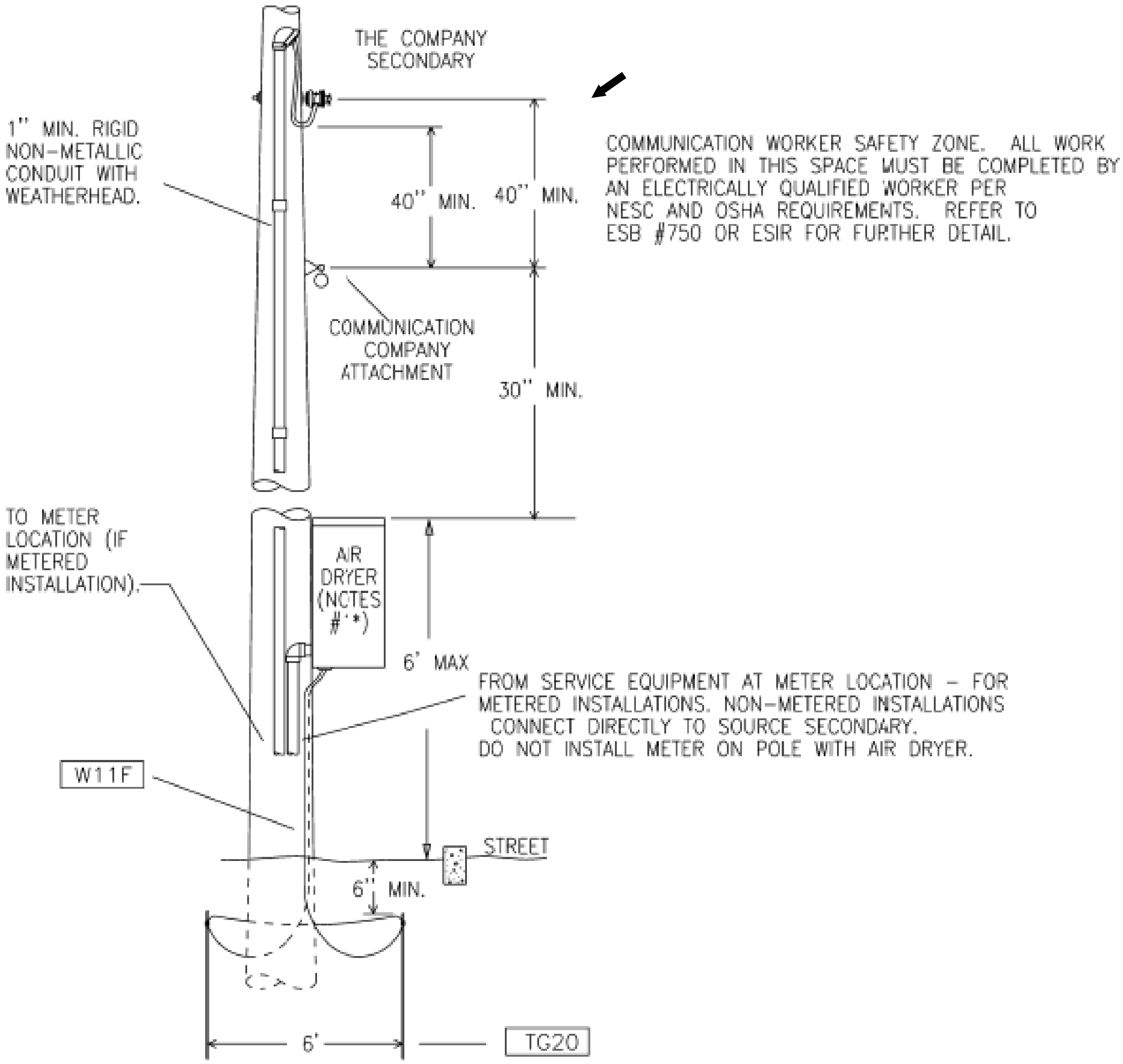

Supersedes 1/06 Issue – Corrected drip loop clearance requirement.

NOTE:

1. AIR DRYER AND ATTACHMENTS (CONDUIT, SUPPLY CONDUCTOR AND GROUNDING) SHALL BE FURNISHED AND INSTALLED BY COMMUNICATION COMPANY.
2. AVOID DRYER INSTALLATION ON POLES REQUIRING REPEATED CLIMBING, JUNCTION POLES, OR POLE USED FOR OTHER EQUIPMENT. BILLING METERINGEQUIPMENT SHALL NOT BE LOCATED ON THE SAME POLE.
3. THE SUPPLY CONDUCTOR (FURNISHED BY COMMUNICATION COMPANY) SHALL BE 600V TW CABLE LONG ENOUGH TO EXTEND 3' ABOVE THE COMPANY SECONDARY.
4. COMMUNICATION CO. TO PROVIDE NEC APPROVED SERVICE EQUIPMENT IF FLATE RATE BILLED. IF METERED, SERVICE EQUIPMENT TO BE LOCATED AT METER LOCATION. SEE ESB #750 FIGURE 29, OR INFORMATION AND REQUIREMENTS FOR ELECTRIC SERVICE FIGURE 904 DEPENDING ON LOCATION.

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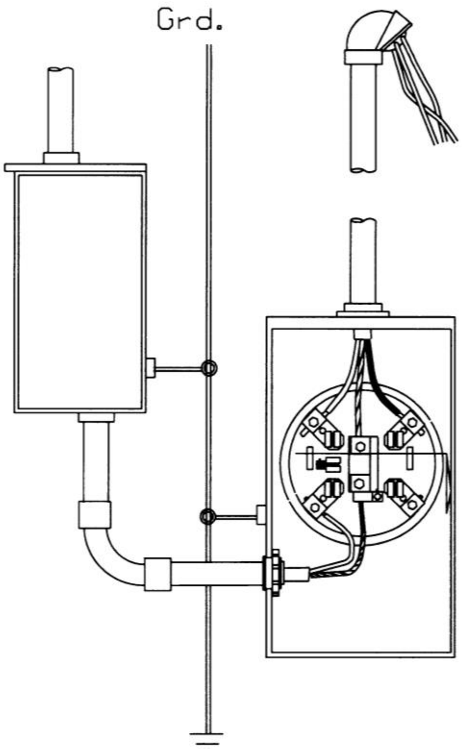
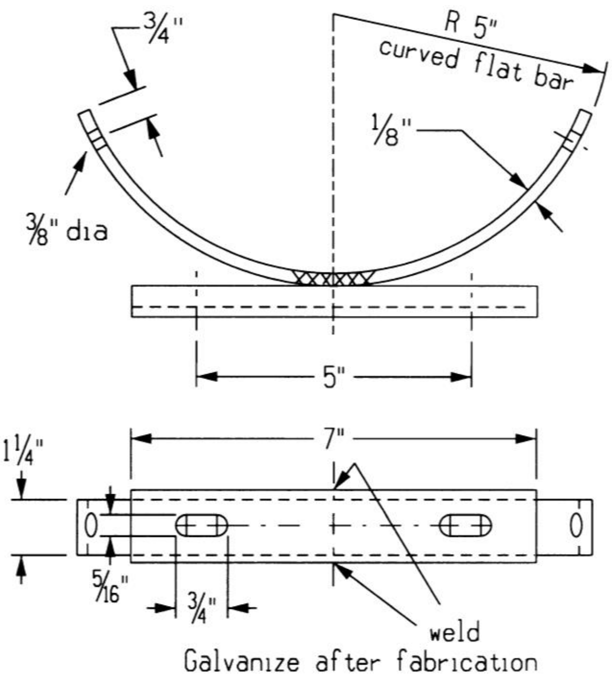
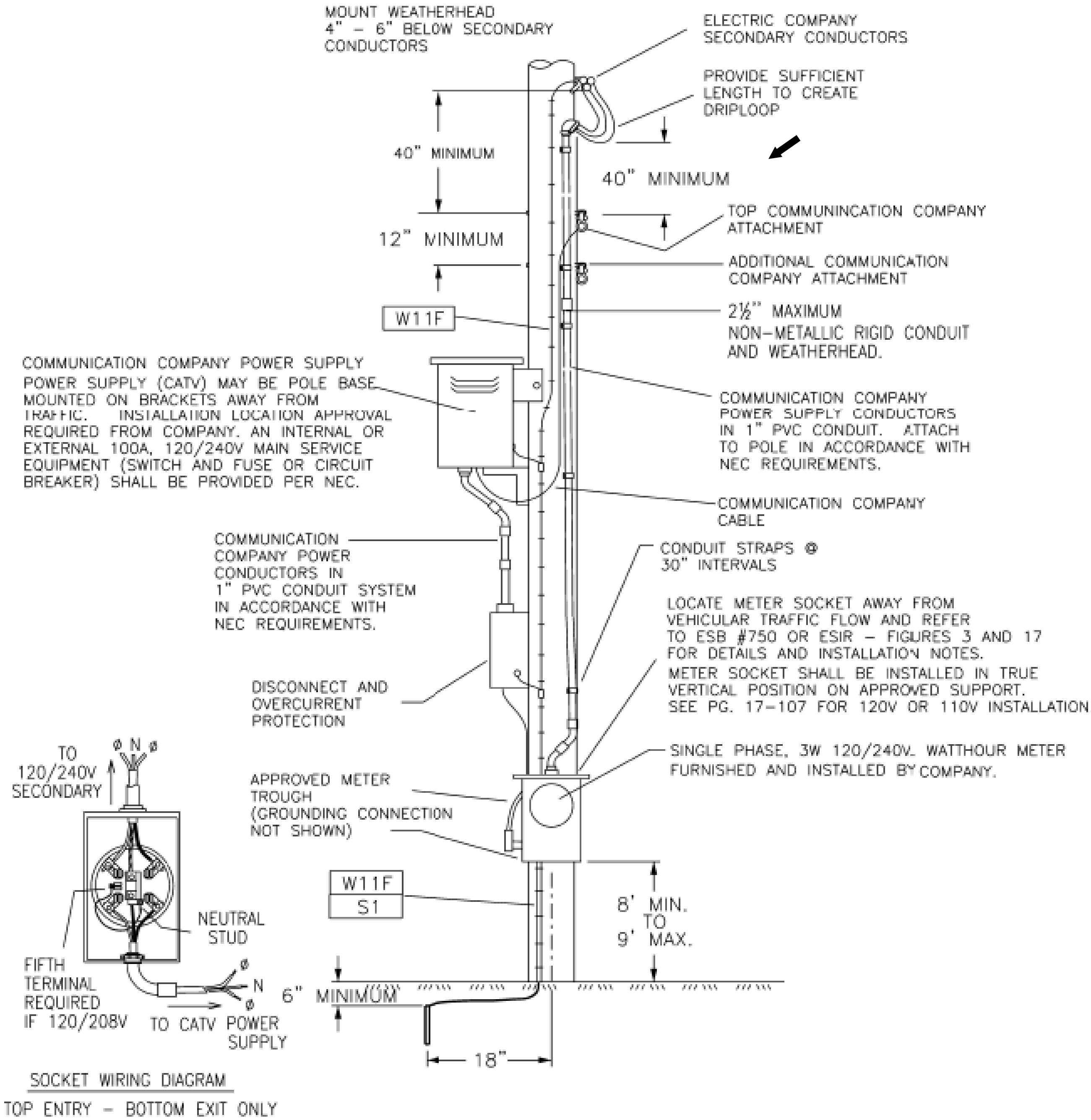

Grd.


3/4"
R 5"
curved flat bar
1/8"
3/8" dia
5"
7"
1 1/4"
5/16"
3/4"
weld
Galvanize after fabrication

Supersedes 7/07 Issue – Corrected drip loop clearance requirement.

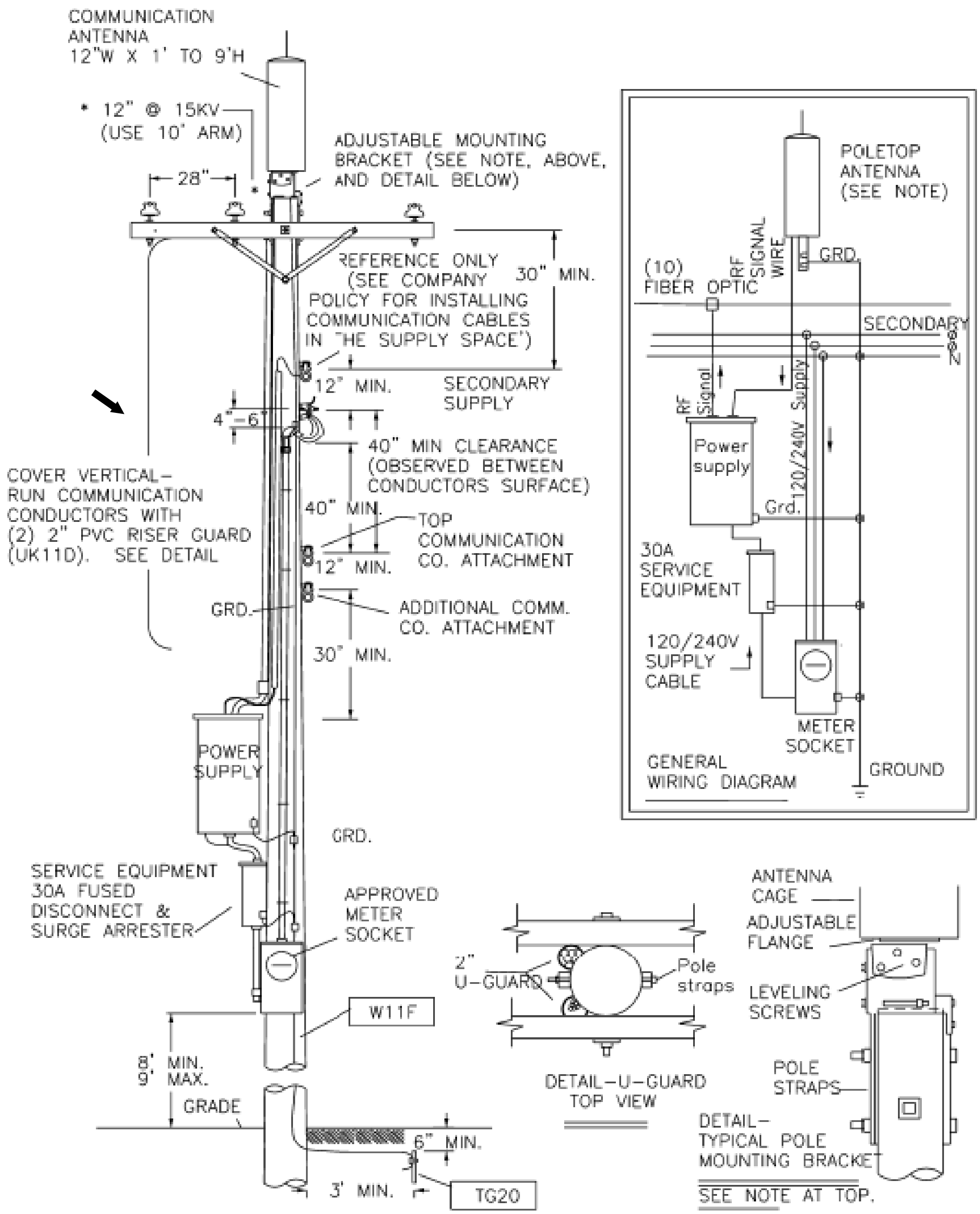


NOTES:

1. ALL NEW OR REPLACEMENT POWER SUPPLIES ARE TO BE METERED. COMM. CO. POWER SUPPLY INSTALLATIONS SHOULD BE AVOIDED ON POLES WITH OTHER EQUIPMENT. POLES SHALL BE ACCESSIBLE BY BUCKET AND THE PROPOSED INSTALLATION SHALL BE FIELD REVIEWED AND APPROVED BY THE COMPANY AND ANY JOINT POLE OWNERS PRIOR TO WORK.

2. COMM. CO. SHALL FURNISH, INSTALL OWN AND MAINTAIN ALL MATERIAL AND EQUIPMENT SHOWN ABOVE EXCEPT AS NOTED. REFER TO ESB #750 OR ELECTRIC SERVICE INFORMATION REQUIREMENTS (ESIR) FIGURE 923 DEPENDING ON LOCATION.

Designer	Drawing	Date
MPR	od17108	11/15/21

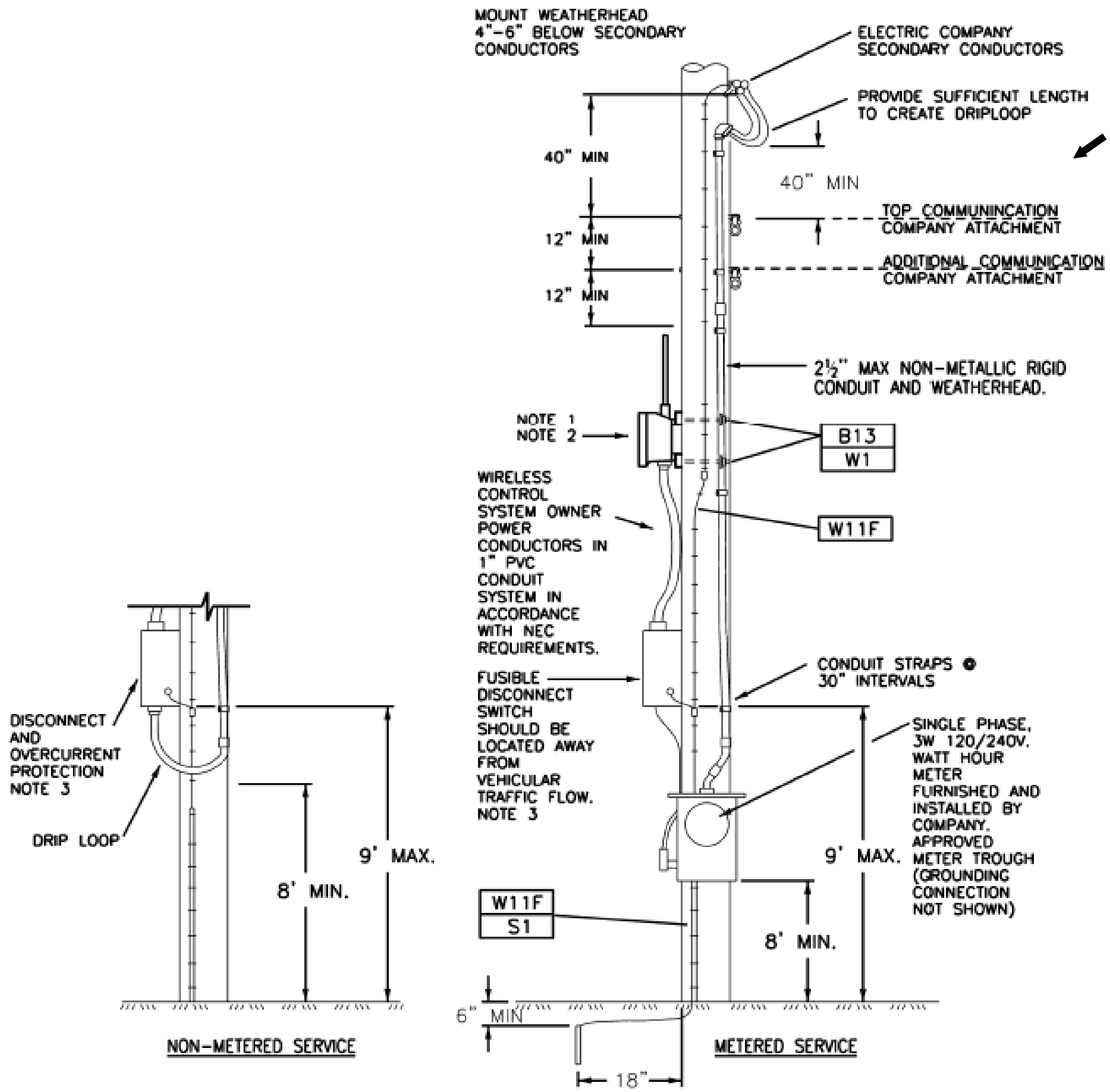


Supersedes 7/07 Issue – Corrected drip loop clearance requirement.

Notes:

1. This arrangement is representative of a typical installation. Similar wireless pole top equipment may be accommodated while maintining the specified clearance requirements. Relocating existing facilities, pole replacement, or installing alternate equipment shall be considered when required.
2. ADFO communication cables may be installed in the supply space of distribution poles <u>only</u> by attachers having an agreement allowing such attachments made prior to January 1, 2010.

Supersedes 7/21 Issue – Corrected drip loop clearance requirement.



NOTES:

1. CONNECTED GRID ROUTER INSTALLATIONS SHOULD BE AVOIDED ON POLES WITH OTHER EQUIPMENT. POLES SHALL BE ACCESSIBLE BY BUCKET AND THE PROPOSED INSTALLATION SHALL BE FIELD REVIEWED AND APPROVED BY THE COMPANY AND ANY JOINT POLE OWNERS PRIOR TO WORK.

2. WIRELESS CONTROL SYSTEM OWNER SHALL FURNISH, INSTALL OWN AND MAINTAIN ALL MATERIAL AND EQUIPMENT SHOWN ABOVE EXCEPT AS NOTED. REFER TO ESB#750 OR ELECTRIC SERVICE INFORMATION REQUIREMENTS (ESIR) FIGURE 923.

3. LOCATE METER SOCKET AWAY FROM VEHICULAR TRAFFIC FLOW AND REFER TO ESB #750 OR ESIR – FIGURES 3 AND 17 FOR DETAILS AND INSTALLATION NOTES. METER SOCKET SHALL BE INSTALLED IN TRUE APPROVED SUPPORT. SEE PG. 17-107 FOR 120V OR 110V INSTALLATION.

5-15kV DISTRIBUTION WOOD POLE MOUNTED COMMUNICATION EQUIPMENT – MOUNTED BELOW COMMUNICATION SPACE			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER: 17- 109A	ISSUE: 7/22

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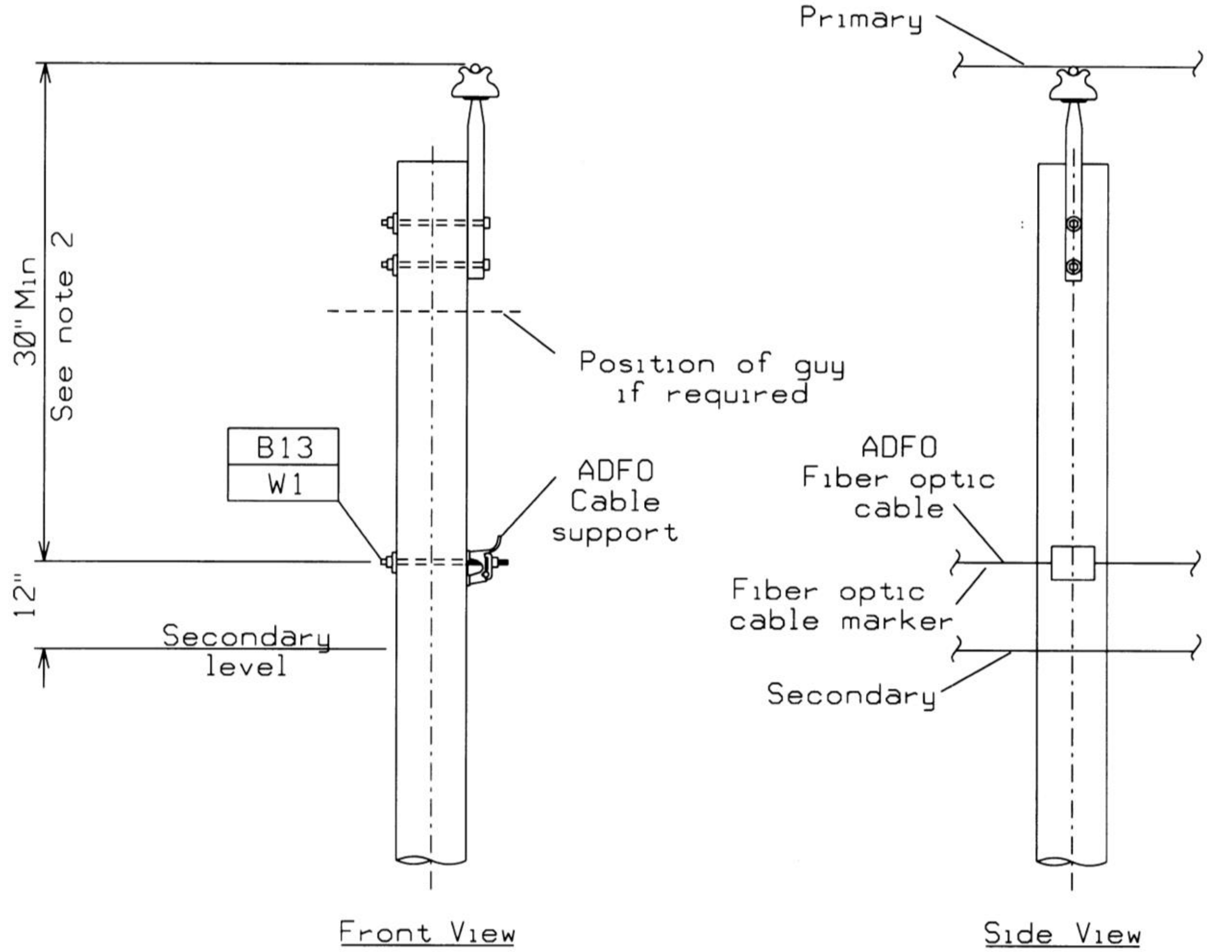
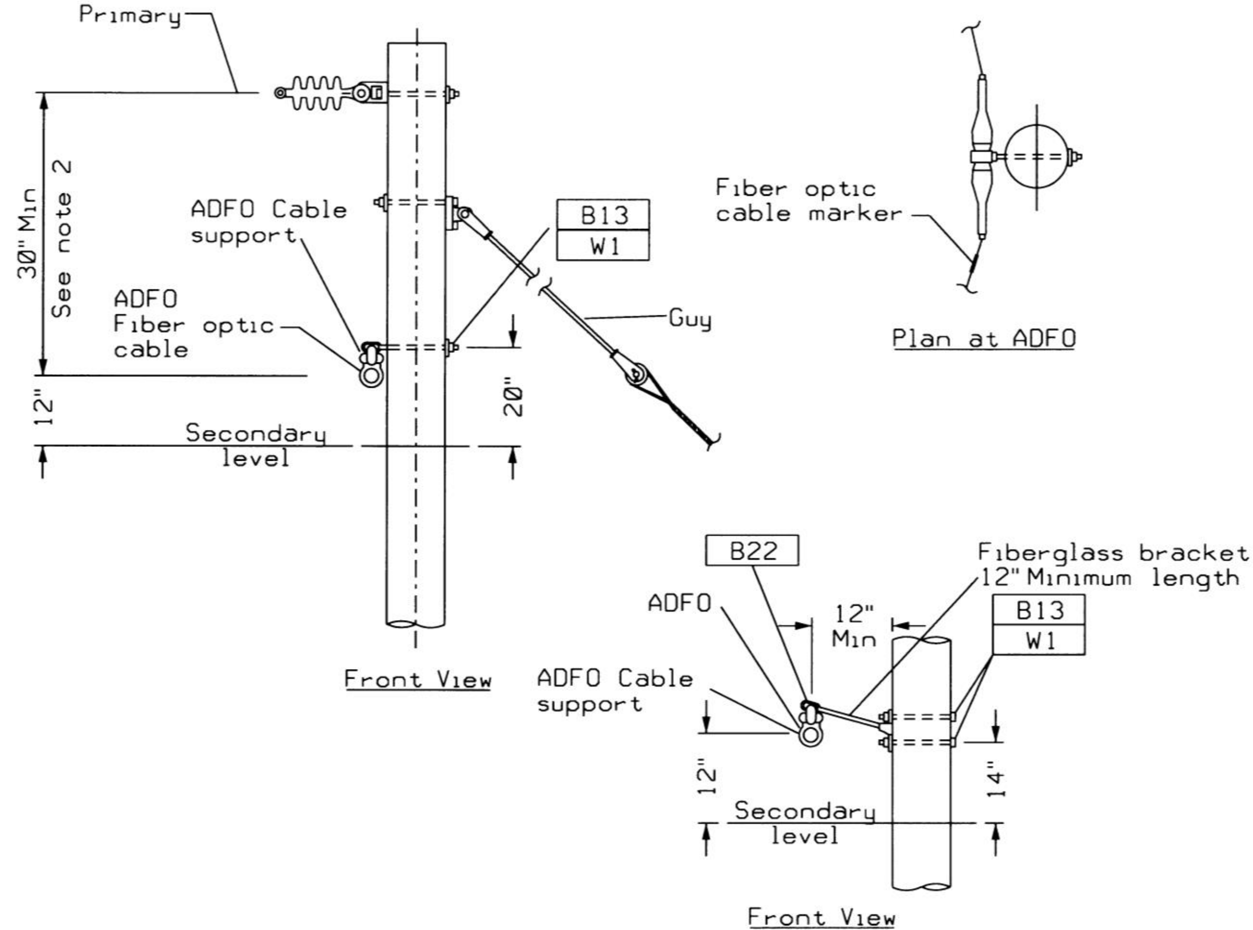
Supersedes 7/10 Issue – Corrected note numbering to match drawing.



Notes:

1. Maximum line angle for ADFO = 20 degrees.
2. Distance between primary wire and ADFO cable shall be a minimum of 30 inches in any direction.
3. ADFO communication cables may be installed in the supply space of distribution poles <u>only</u> by attachers having an agreement allowing such attachments made prior to January 1, 2010.

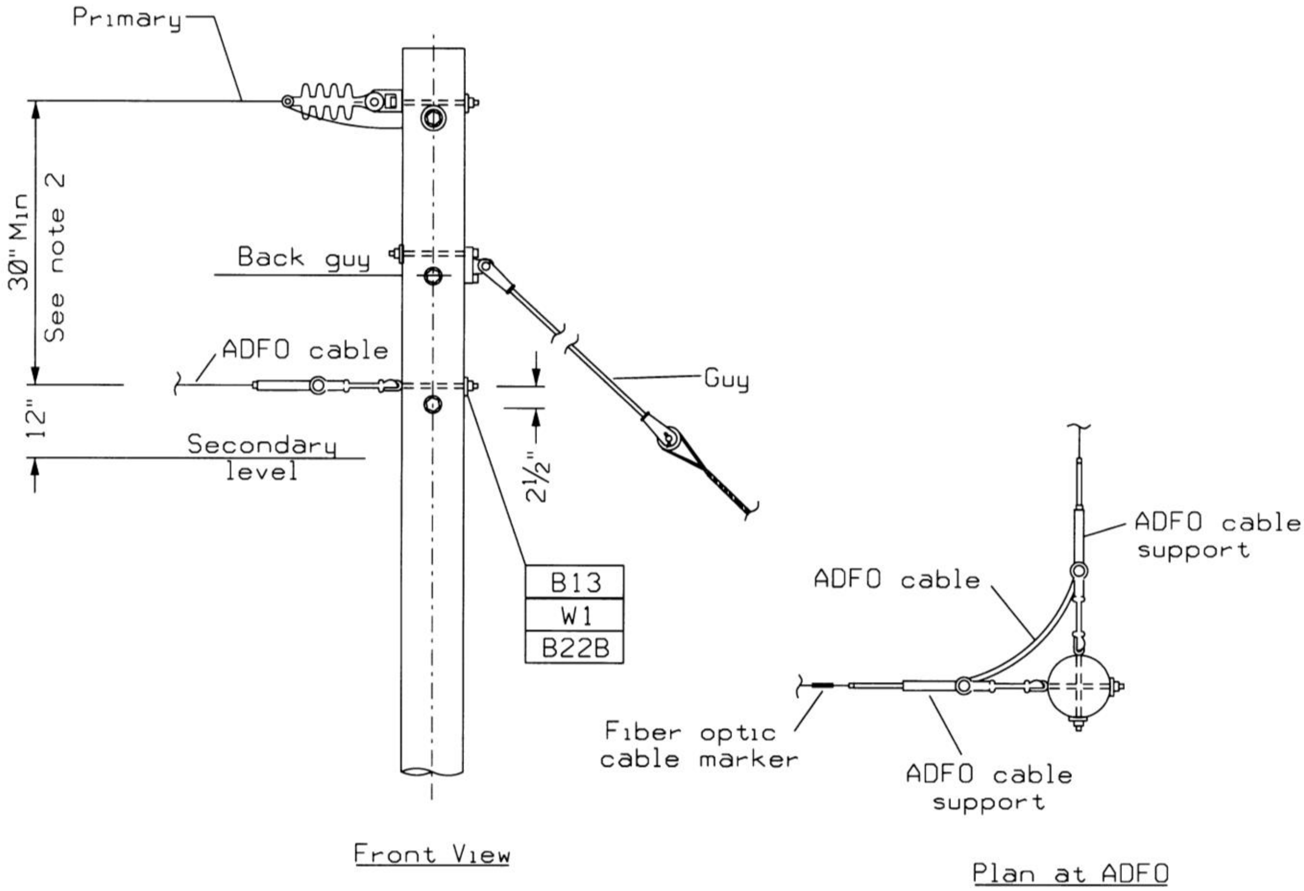


Supersedes 7/10 Issue – Corrected note numbering to match drawing.

Notes:

1. Maximum line angle for ADFO = 30 degrees.
2. Distance between primary wire and ADFO cable shall be a minimum of 30 inches in any direction.
3. Item 5, fiberglass bracket, is for use on tangent and angle structures only. Not for use on deadends.
4. ADFO communication cables may be installed in the supply space of distribution poles only by attachers having an agreement allowing such attachments made prior to January 1, 2010.

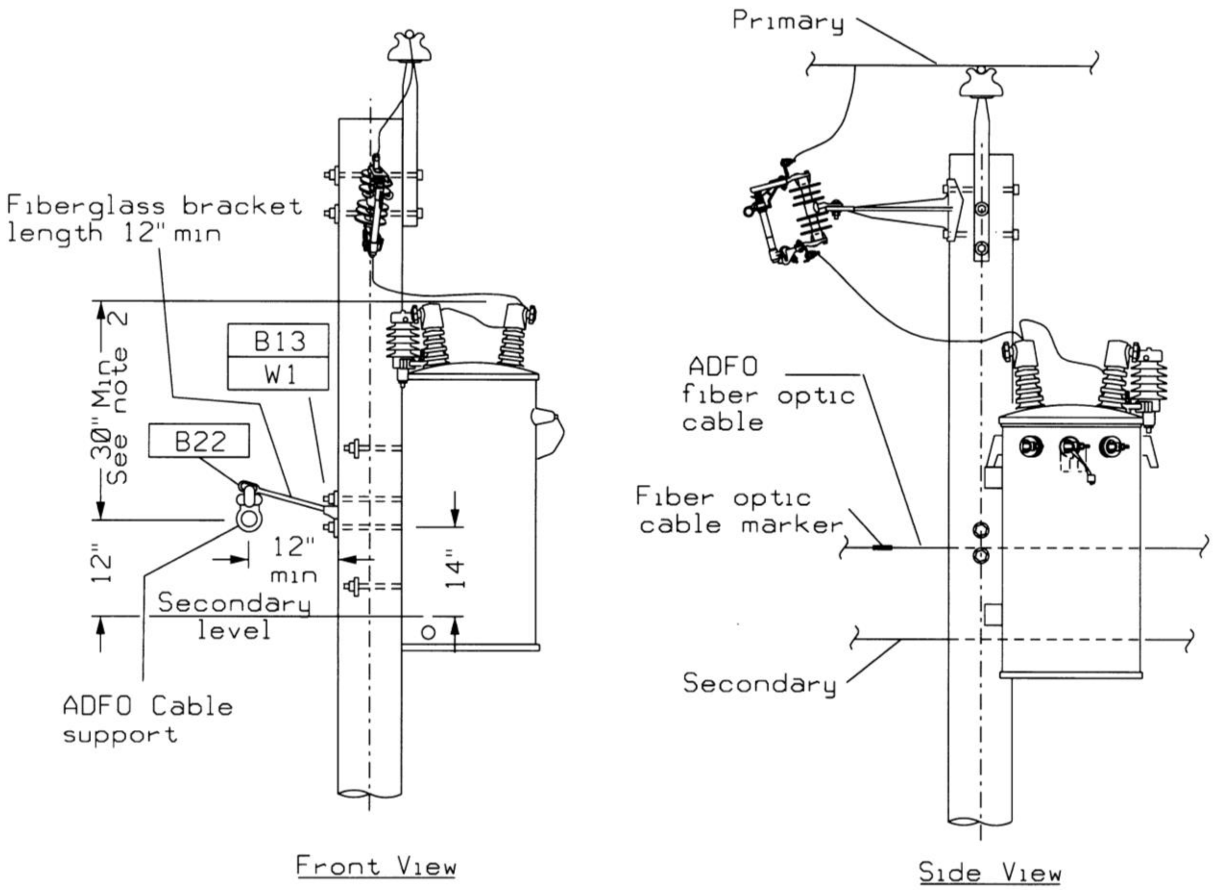
Supersedes 7/10 Issue – Corrected note numbering to match drawing.



Notes:

1. Maximum line angle for ADFO = 90 degrees.
2. Distance between primary wire and ADFO cable shall be a minimum of 30 inches in any direction.
3. ADFO communication cables may be installed in the supply space of distribution poles <u>only</u> by attachers having an agreement allowing such attachments made prior to January 1, 2010.

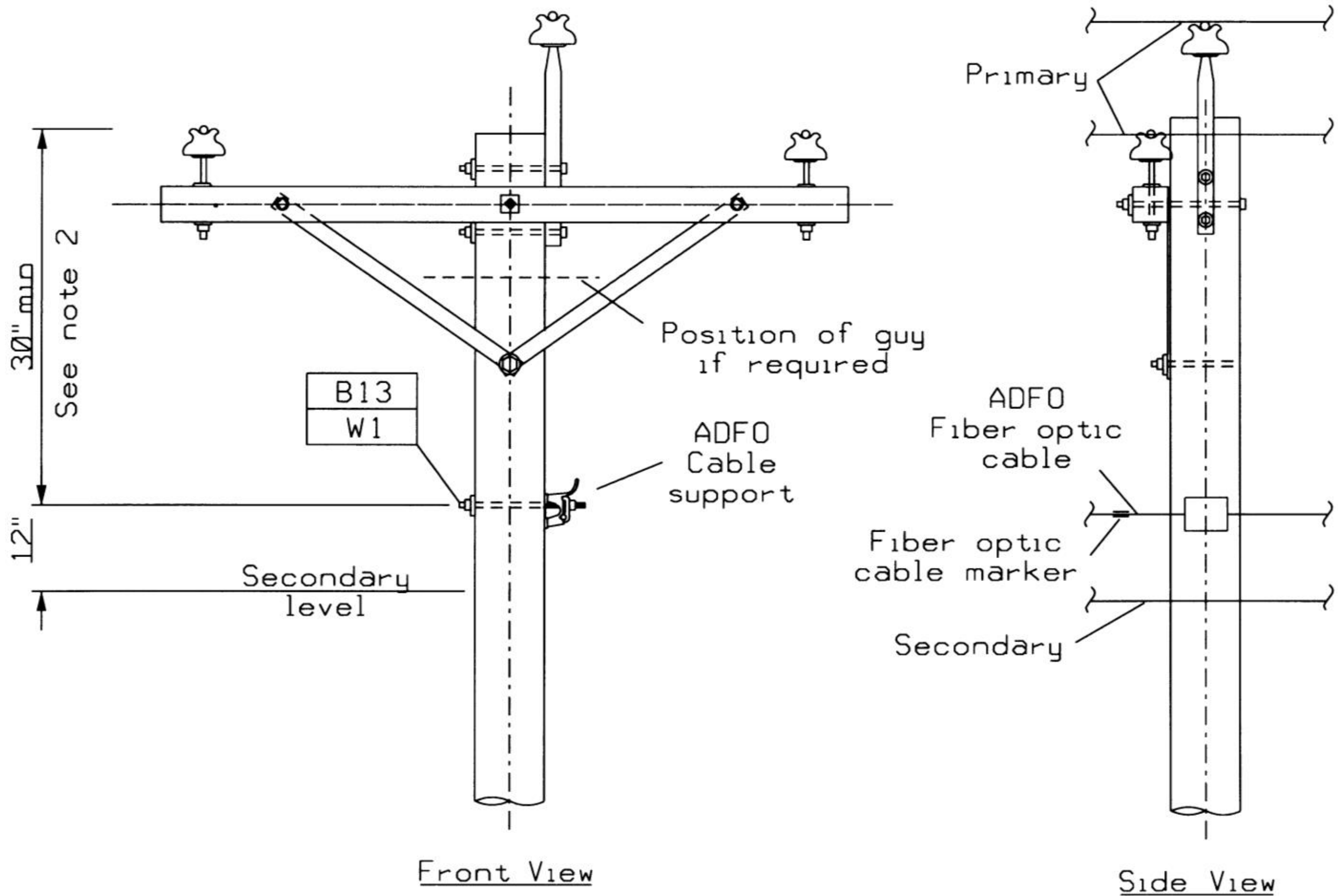
SINGLE PHASE CORNER DEADEND WITH ALL DIELECTRIC FIBER OPTIC CABLE BETWEEN PRIMARY AND SECONDARY ATTACHMENTS			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 17-112	ISSUE 7/19



Supersedes 7/10 Issue – Corrected note numbering to match drawing.

Notes:

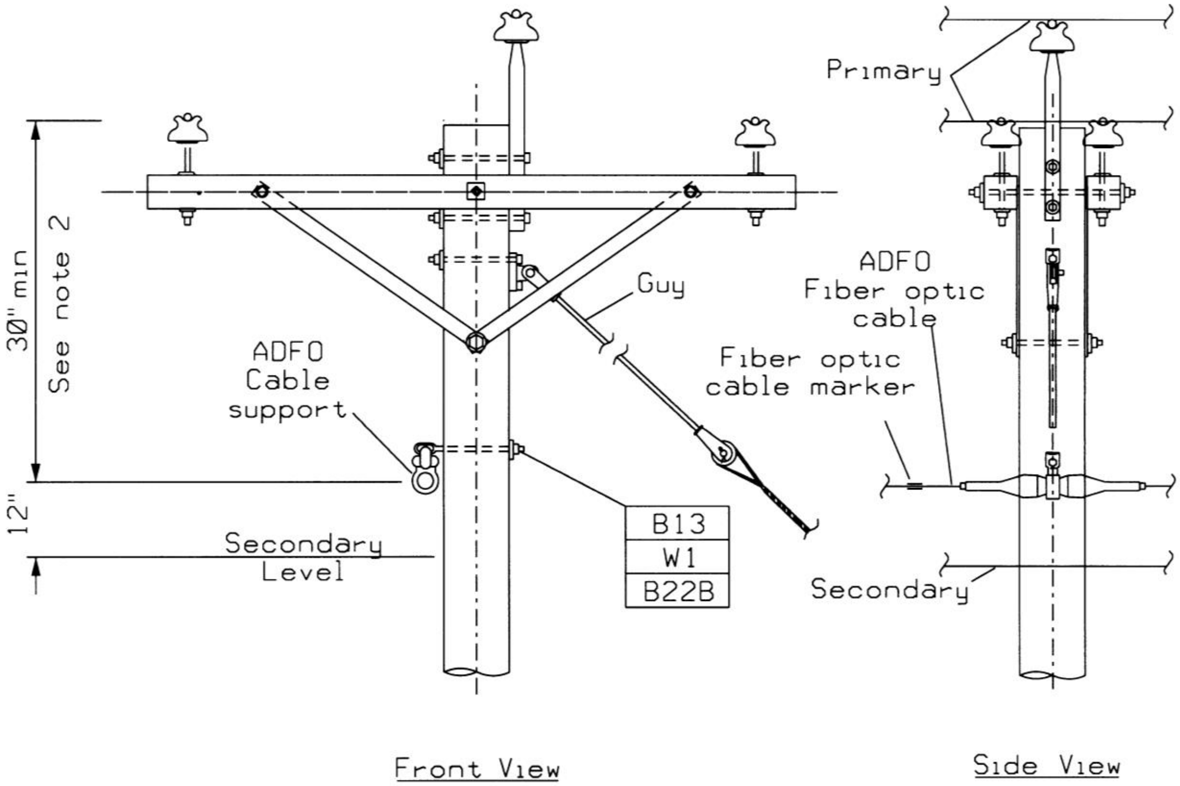
1. Maximum line angle for ADFO = 30 degrees.
2. Distance between primary wire and ADFO cable shall be a minimum of 30 inches in any direction.
3. ADFO communication cables may be installed in the supply space of distribution poles only by attachers having an agreement allowing such attachments made prior to January 1, 2010.



Supersedes 7/10 Issue – Corrected note numbering to match drawing.

Notes:

1. Maximum line angle for ADFO = 20 degrees.
2. Distance between primary wire and ADFO cable shall be a minimum of 30 inches in any direction.
3. ADFO communication cables may be installed in the supply space of distribution poles only by attachers having an agreement allowing such attachments made prior to January 1, 2010.

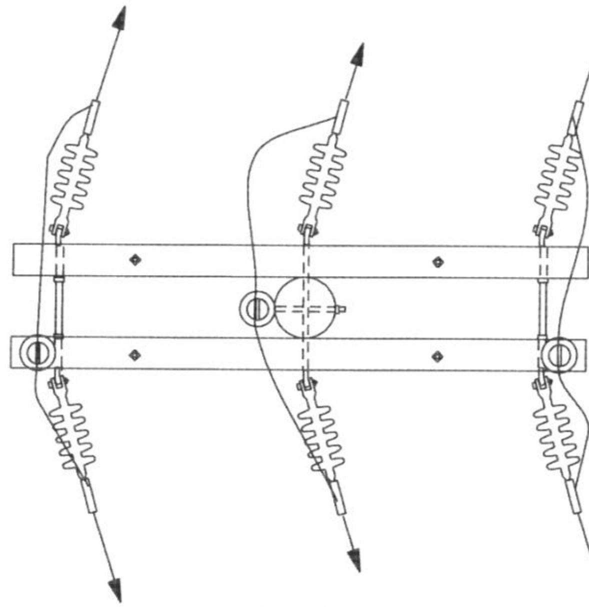


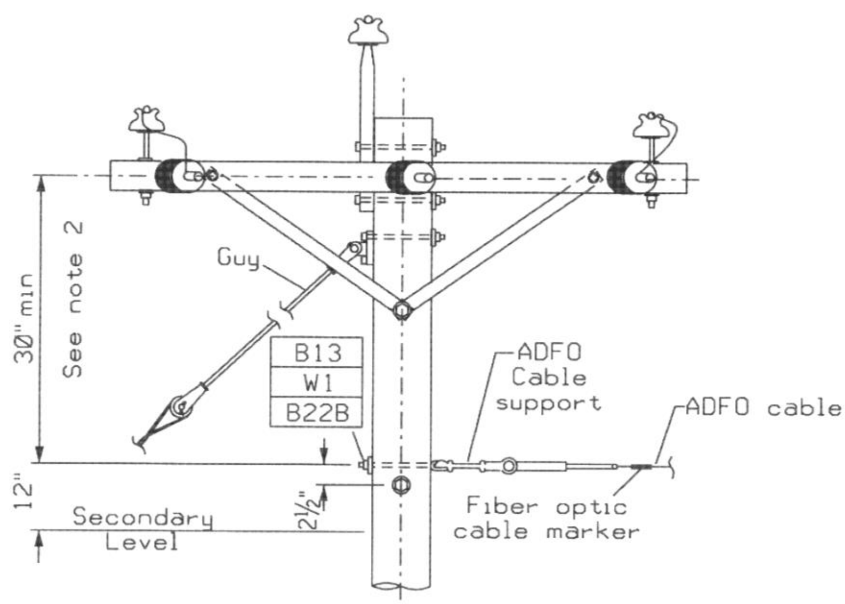
Supersedes 7/10 Issue – Corrected note numbering to match drawing.

Notes:

1. Maximum line angle for ADFO = 30 degrees.
2. Distance between primary wire and ADFO cable shall be a minimum of 30 inches in any direction.
3. ADFO communication cables may be installed in the supply space of distribution poles <u>only</u> by attachers having an agreement allowing such attachments made prior to January 1, 2010.

Supersedes 7/10 Issue – Corrected note numbering to match drawing.

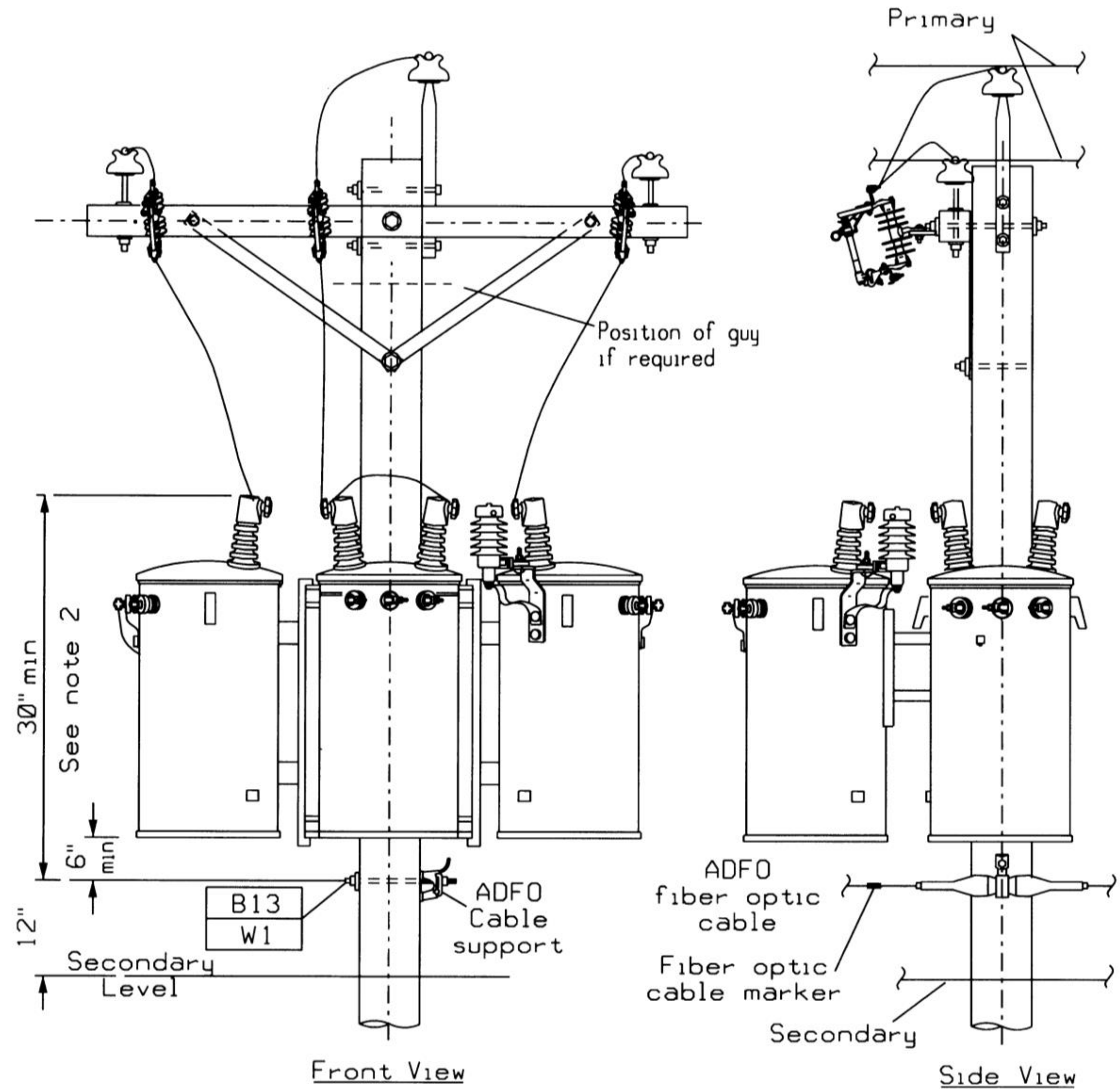




Notes:

1. Maximum line angle for ADFO = 30 degrees.
2. Distance between primary wire and ADFO cable shall be a minimum of 30 inches in any direction.
3. *ADFO communication cables may be installed in the supply space of distribution poles <u>only</u> by* attachers having an agreement allowing such attachments made prior to January 1, 2010.

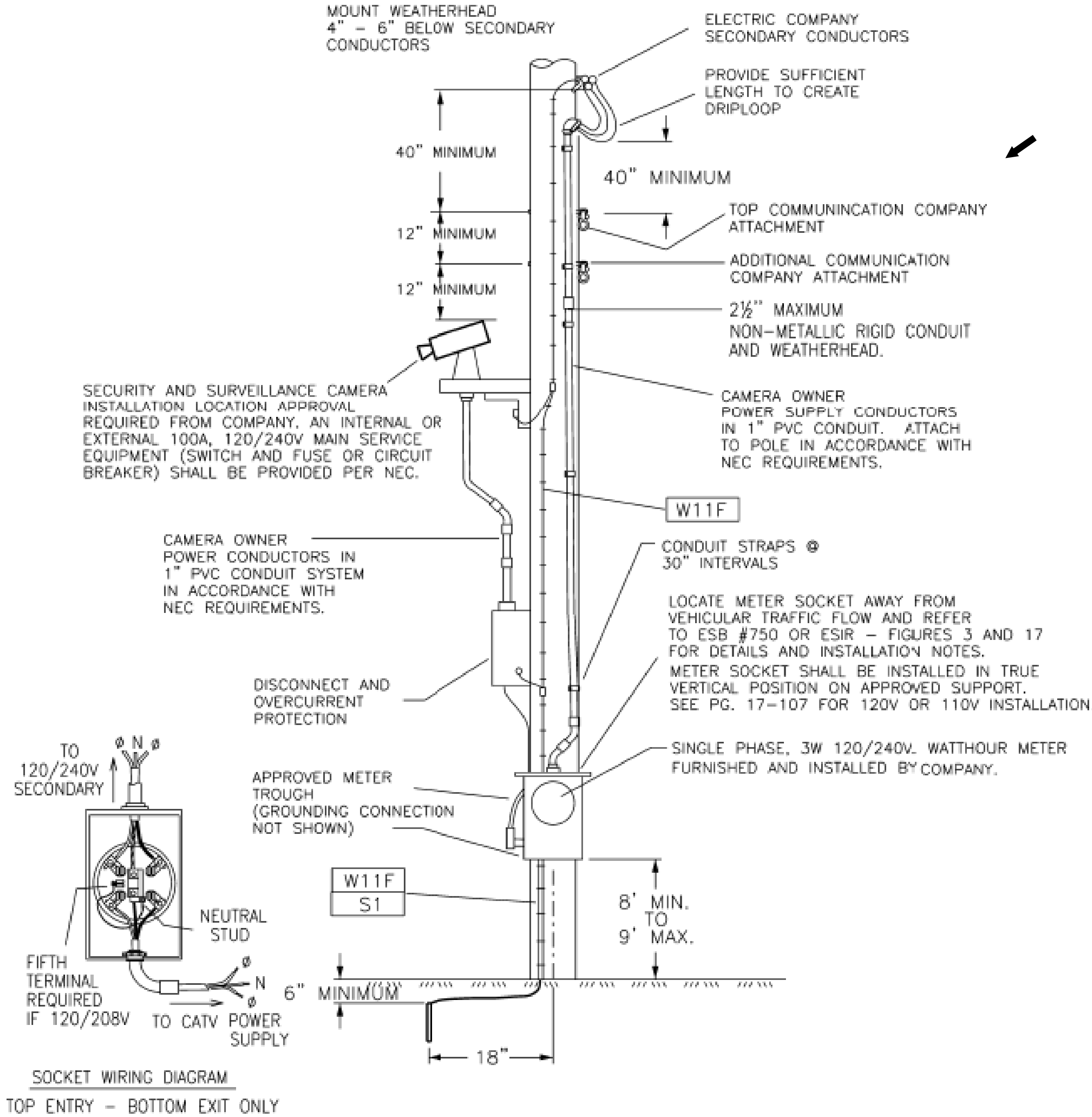
THREE PHASE DEADEND DOUBLE CROSSARM WITH ALL DIELECTRIC FIBER OPTIC (ADFO) CABLE BETWEEN PRIMARY AND SECONDARY ATTACHMENTS			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 17-116	ISSUE 7/19



Supersedes 7/10 Issue – Corrected note numbering to match drawing.

Notes:

1. Maximum line angle for ADFO = 20 degrees.
2. Distance between primary wire and ADFO cable shall be a minimum of 30 inches in any direction.
3. ADFO communication cables may be installed in the supply space of distribution poles <u>only</u> by attachers having an agreement allowing such attachments made prior to January 1, 2010.



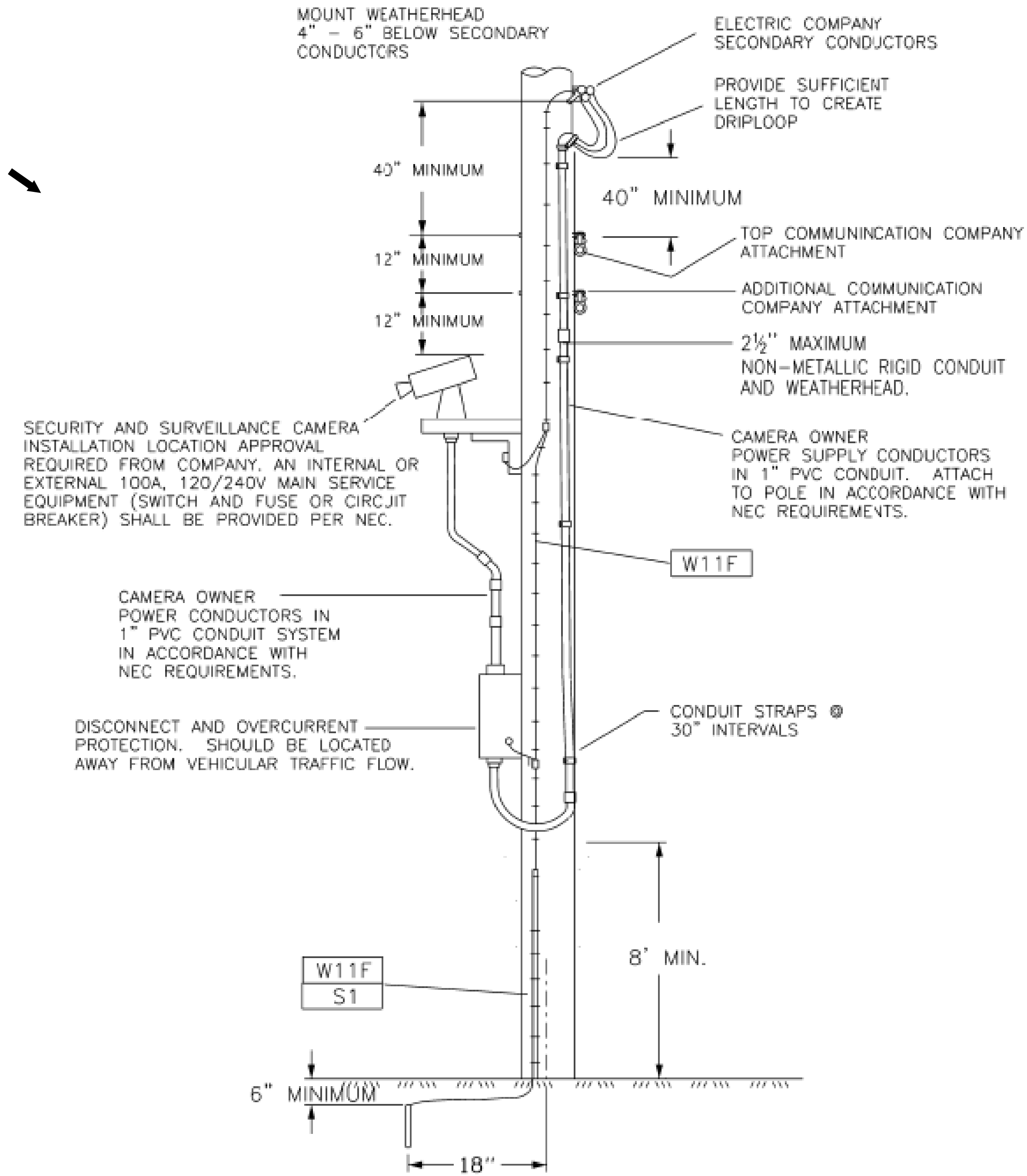
Supersedes 7/07 Issue – Corrected drip loop clearance requirement.

NOTES:

1. CAMERA POWER SUPPLY INSTALLATIONS SHOULD BE AVOIDED ON POLES WITH OTHER EQUIPMENT. POLES SHALL BE ACCESSIBLE BY BUCKET AND THE PROPOSED INSTALLATION SHALL BE FIELD REVIEWED AND APPROVED BY THE COMPANY AND ANY JOIINT POLE OWNERS PRIOR TO WORK.

2. CAMERA OWNER SHALL FURNISH, INSTALL OWN AND MAINTAIN ALL MATERIAL AND EQUIPMENT SHOWN ABOVE EXCEPT AS NOTED. REFER TO ESB #750 OR ELECTRIC SERVICE INFORMATION REQUIREMENTS (ESIR) FIGURE 923 DEPENDING ON LOCATION.

Designer	Drawing	Date
MPR	od17118	11/15/21



NOTES:

1. CAMERA POWER SUPPLY INSTALLATIONS SHOULD BE AVOIDED ON POLES WITH OTHER EQUIPMENT. POLES SHALL BE ACCESSIBLE BY BUCKET AND THE PROPOSED INSTALLATION SHALL BE FIELD REVIEWED AND APPROVED BY THE COMPANY AND ANY JOIINT POLE OWNERS PRIOR TO WORK.

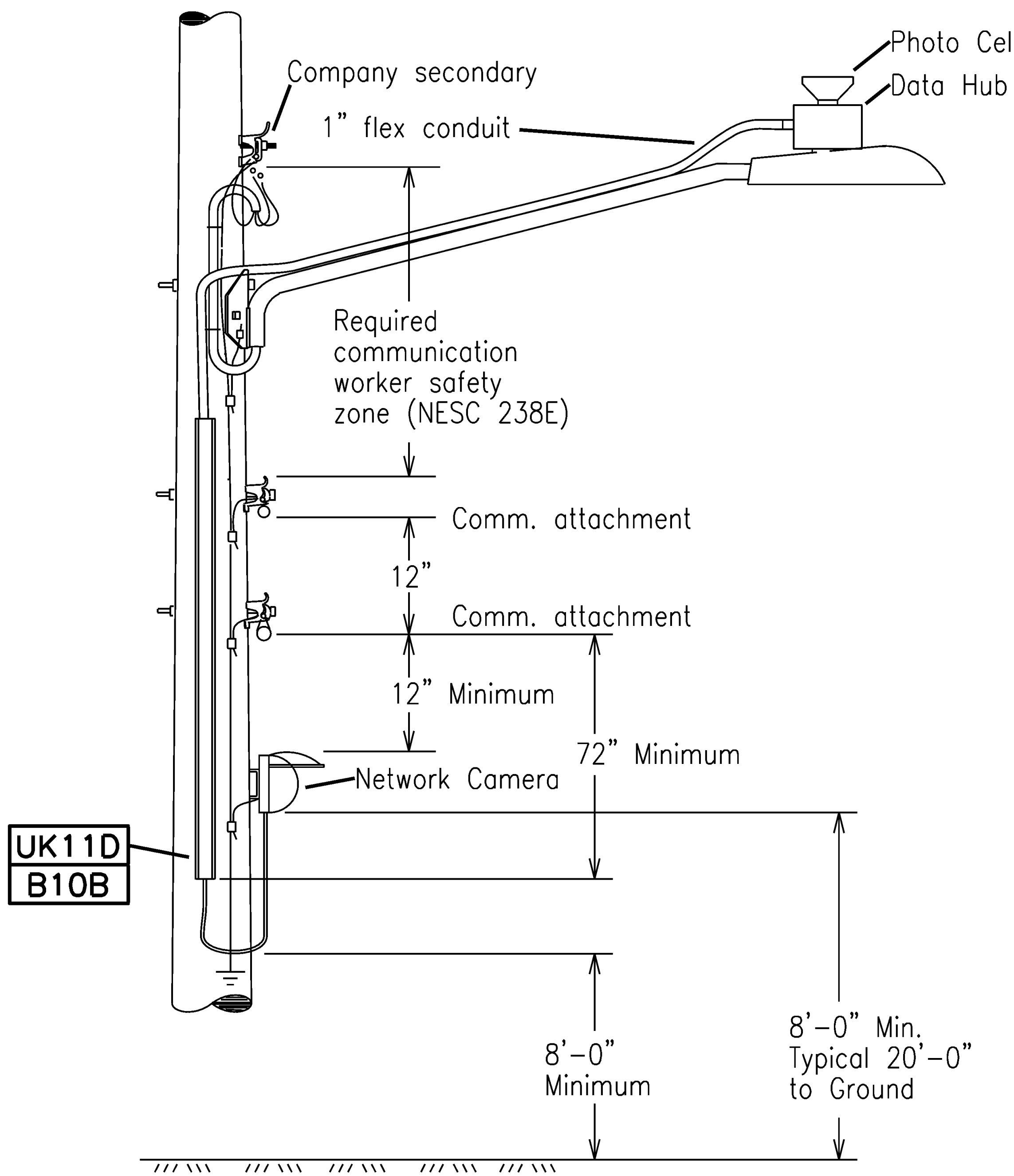
2. CAMERA OWNER SHALL FURNISH, INSTALL OWN AND MAINTAIN ALL MATERIAL AND EQUIPMENT SHOWN ABOVE EXCEPT AS NOTED. REFER TO ESB #750 OR ELECTRIC SERVICE INFORMATION REQUIREMENTS (ESIR) FIGURE 923 DEPENDING ON LOCATION.

Designer	Drawing	Date
MPR	od17119	11/15/21

Supersedes 7/07 Issue – Corrected drip loop clearance requirement.

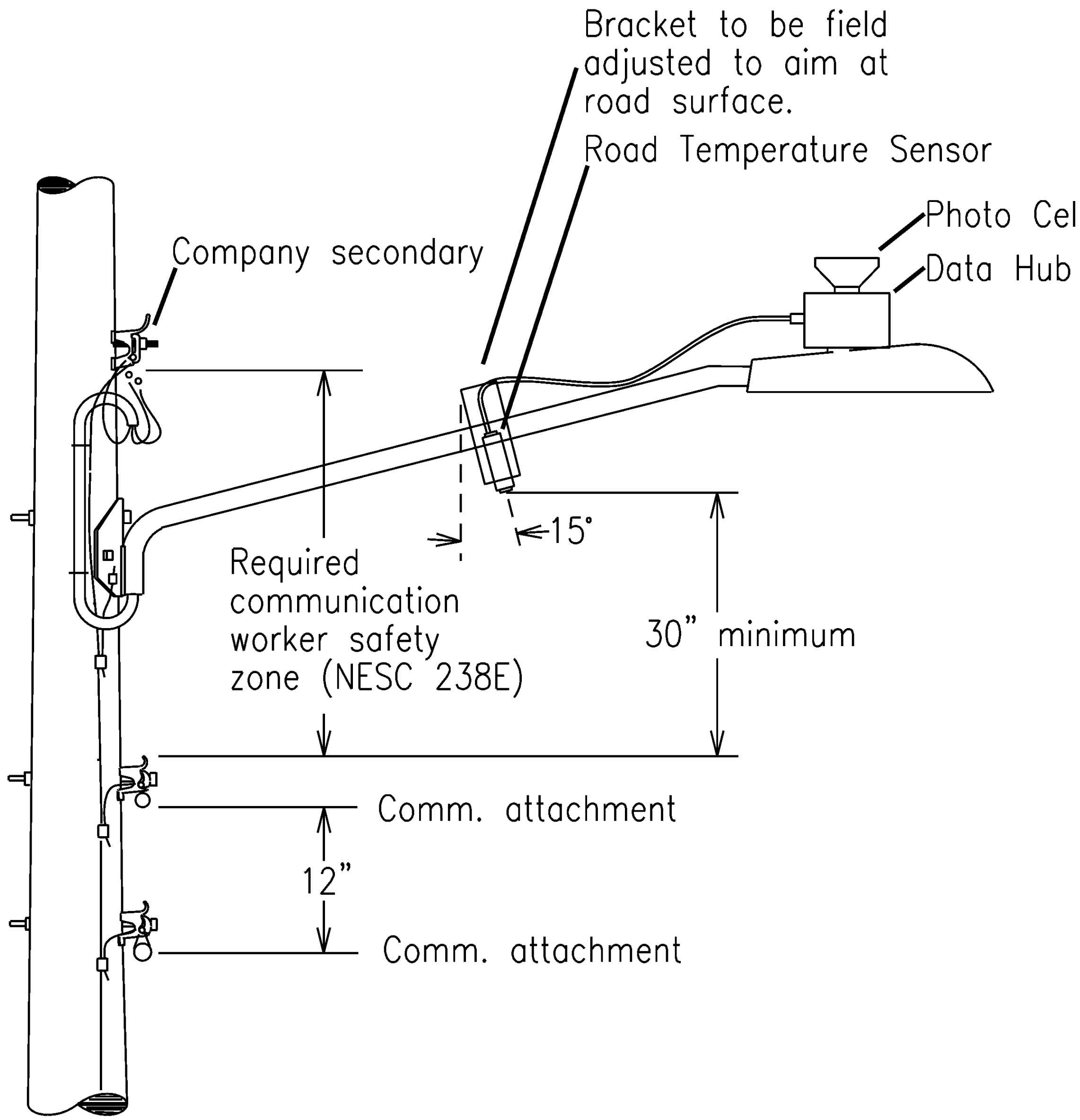
DISTRIBUTION WOOD POLE MOUNTED SECURITY OR SURVEILLANCE CAMERA NON-METERED SERVICE

ISSUE	PAGE NUMBER		
7/22	17-119	OVERHEAD CONSTRUCTION STANDARD	ppl



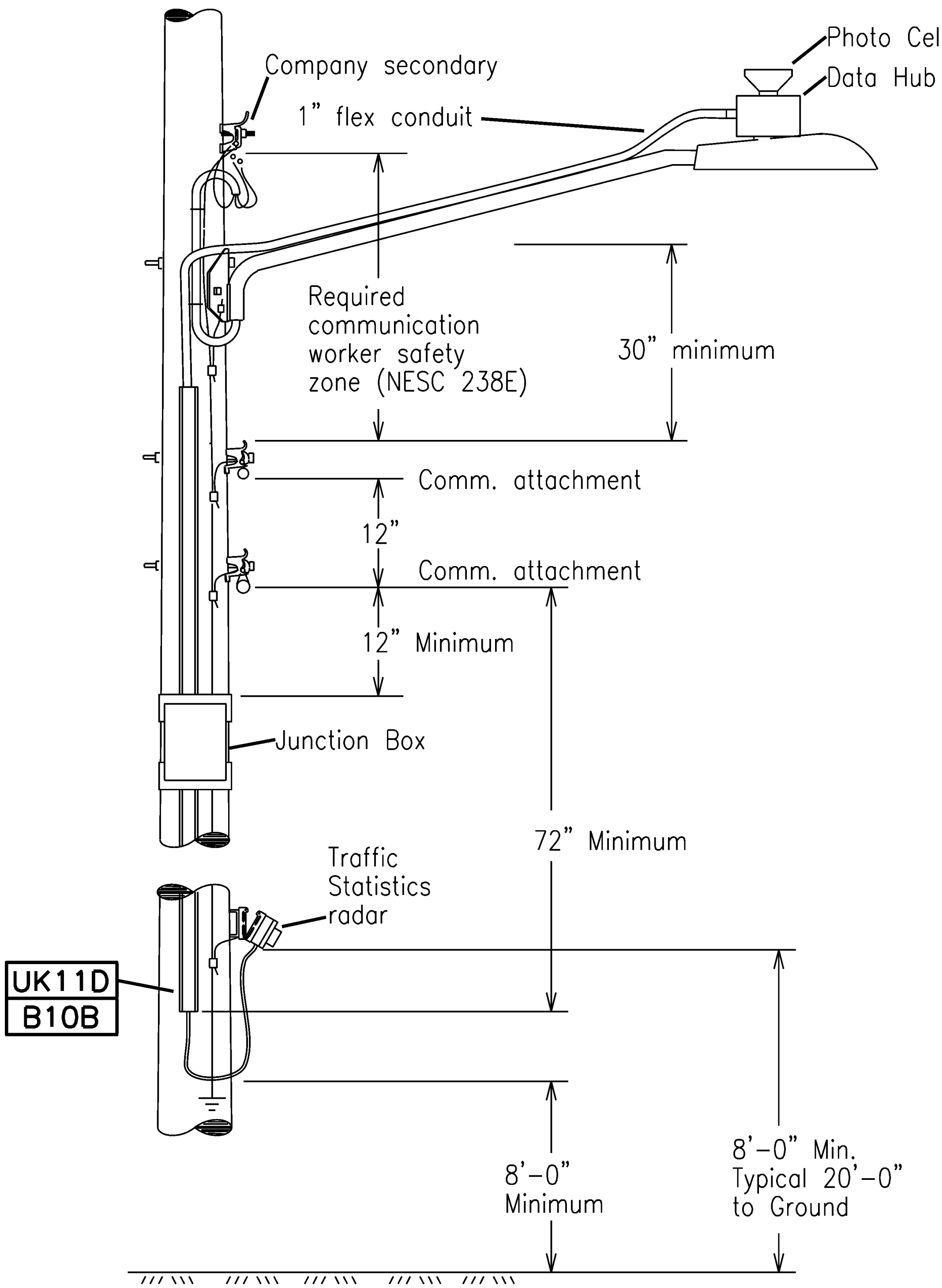
New construction drawing.

5-15kV DISTRIBUTION WOOD POLE MOUNTED COMMUNICATION EQUIPMENT – SMART CITY DATA HUB CONNECTED NETWORK CAMERA

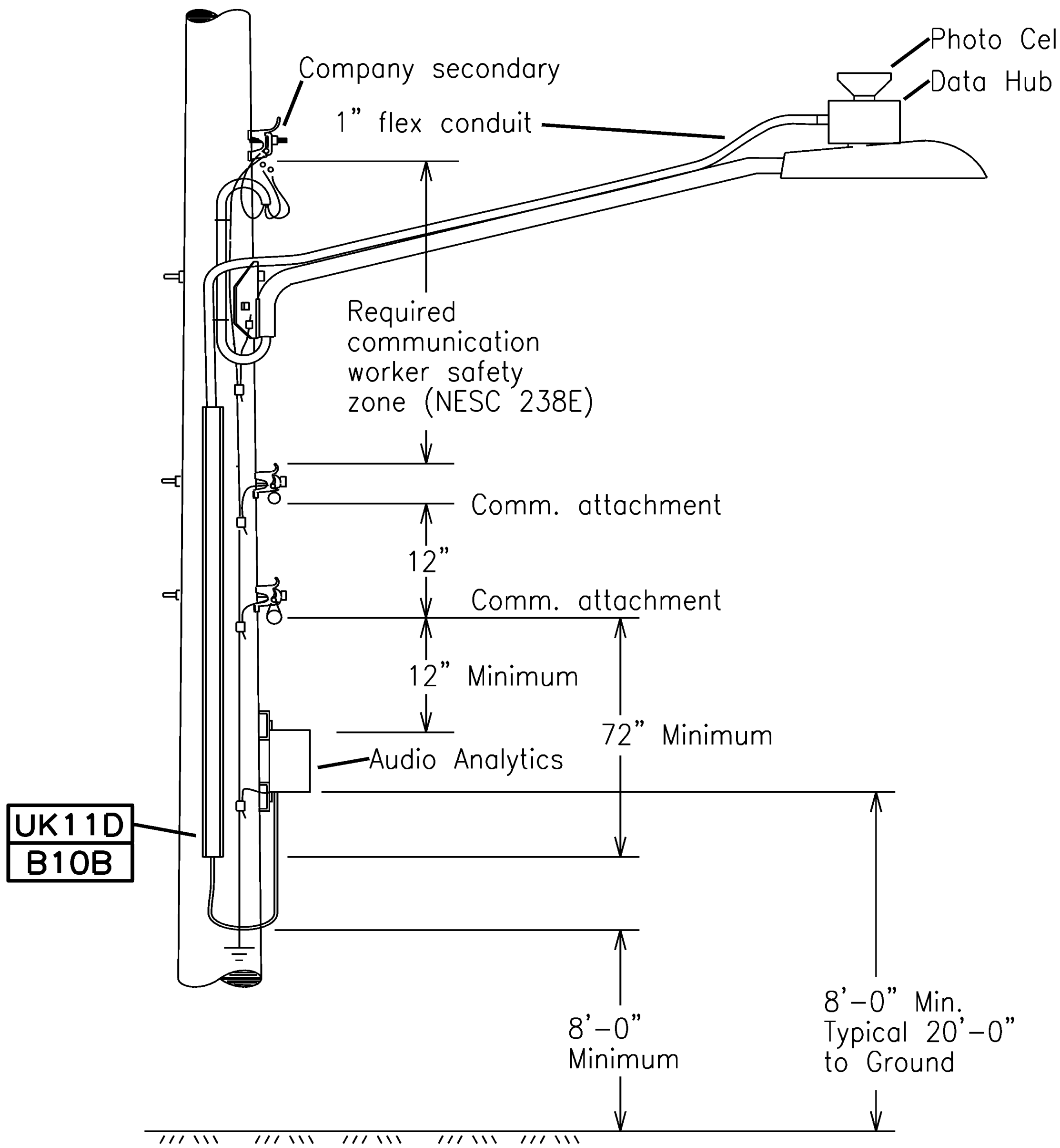


New construction drawing.

New construction drawing.

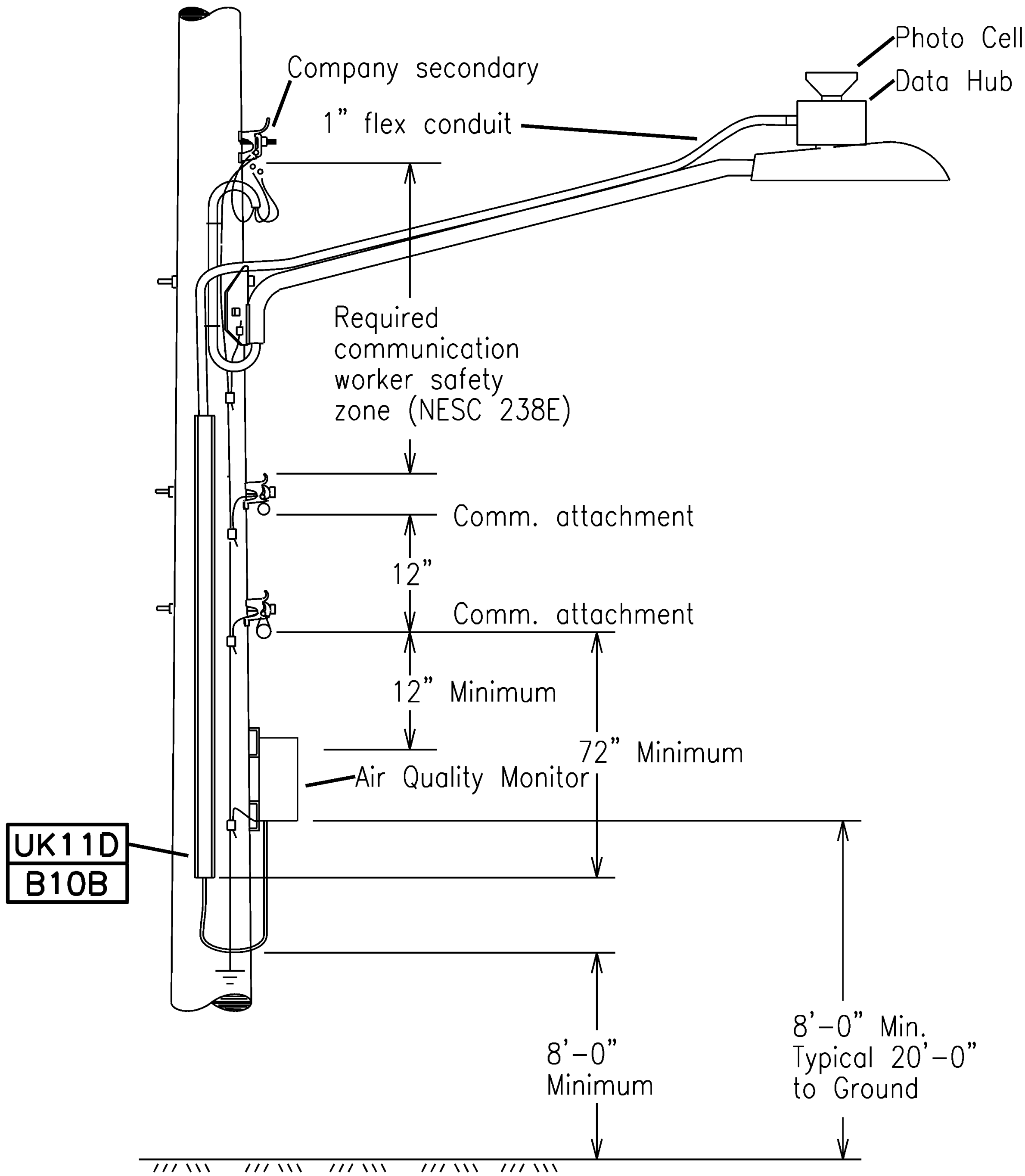


5-15kV DISTRIBUTION WOOD POLE MOUNTED COMMUNICATION EQUIPMENT – SMART CITY DATA HUB CONNECTED TRAFFIC ANALYTICS			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER **17- 124**	ISSUE **7/20**

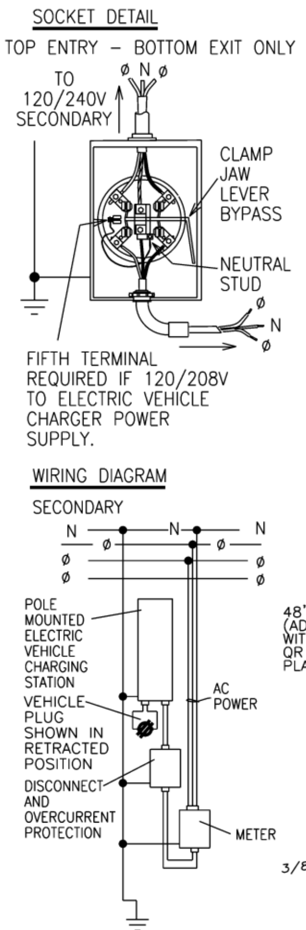


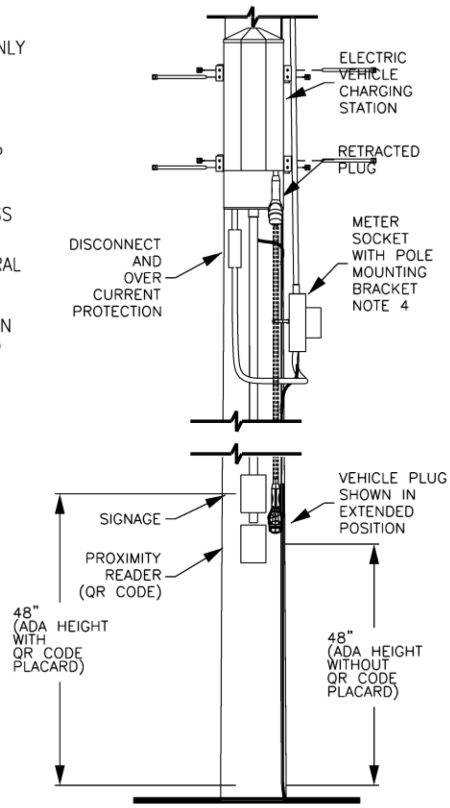
New construction drawing.

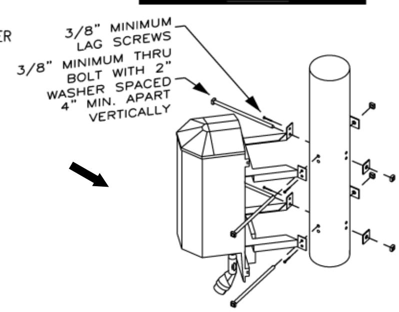
7/20 - New construction drawing.

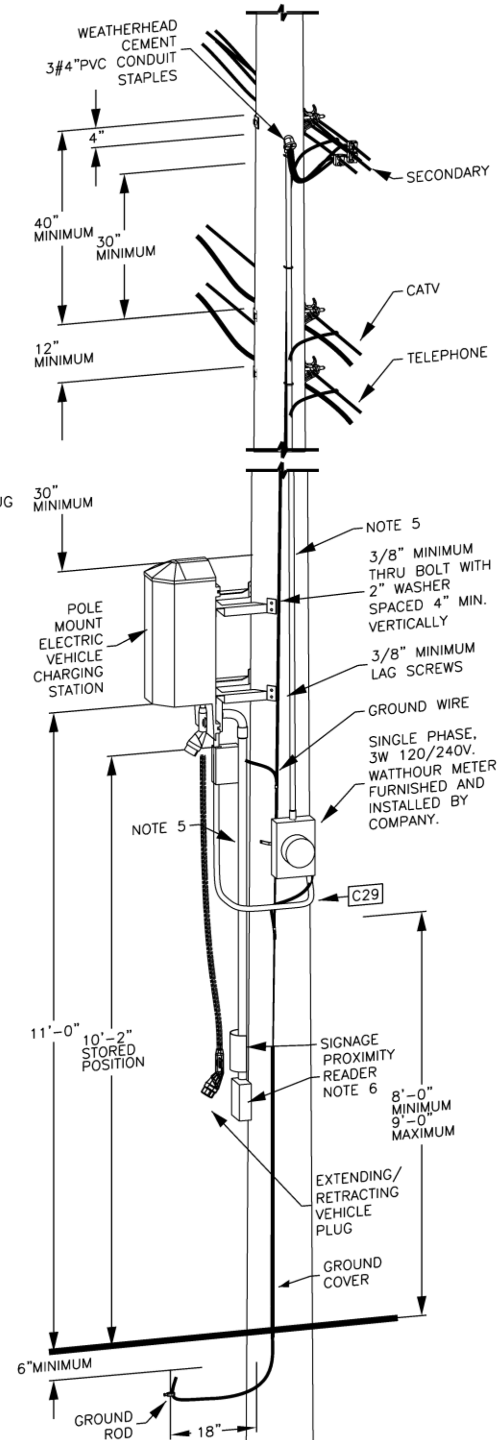


5-15kV DISTRIBUTION WOOD POLE MOUNTED COMMUNICATION EQUIPMENT – SMART CITY DATA HUB CONNECTED AIR QUALITY MONITOR









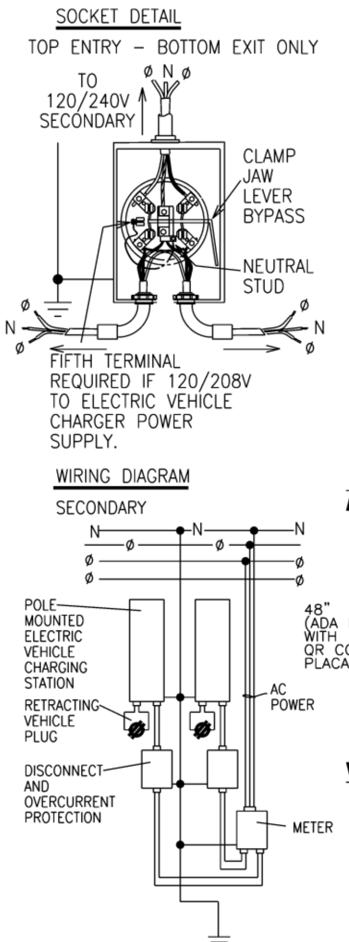
7/21 - New bracket to move charging station off pole face.

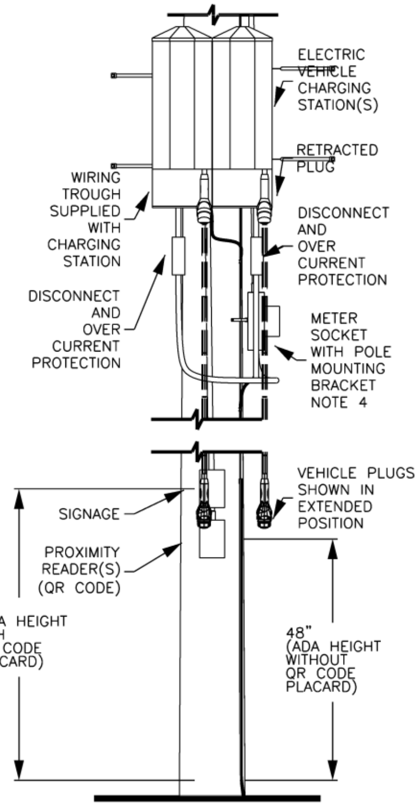
NOTE:

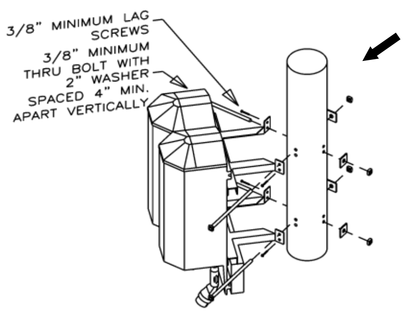
1. ALL NEW OR REPLACEMENT ELECTRIC VEHICLE CHARGING STATIONS TO BE METERED. INSTALLATIONS SHOULD BE AVOIDED ON POLES WITH OTHER EQUIPMENT. POLES SHALL BE ACCESSIBLE BY BUCKET AND THE PROPOSED INSTALLATION SHALL BE FIELD REVIEWED AND APPROVED BY THE COMPANY AND ANY JOINT POLE OWNERS PRIOR TO WORK.
2. CUSTOMER SHALL FURNISH, INSTALL, OWN AND MAINTAIN ALL MATERIAL AND EQUIPMENT SHOWN ABOVE EXCEPT AS NOTED. REFER TO ESB #750.
3. LOCATE METER SOCKET AWAY FROM VEHICULAR TRAFFIC FLOW AND REFER TO ESB #750 FOR DETAILS AND INSTALLATION NOTES. METER SOCKET SHALL BE INSTALLED IN TRUE VERTICAL POSITION ON APPROVED SUPPORT. SEE PG. 17–107 FOR APPROVED SUPPORT DETAILS.
4. SERVICE EQUIPMENT AMP RATING TO BE DETERMINED BY INSTALLER PER NEC REQUIREMENTS.
5. ALL CONDUCTORS IN NON–METALLIC RIGID CONDUIT ATTACH TO POLE IN ACCORDANCE WITH NEC REQUIREMENTS.
6. PROXIMITY READER AND SIGNAGE SHALL BE MOUNTED FLUSH TO POLE TO AVOID MAKING THE POLE READILY CLIMBABLE.

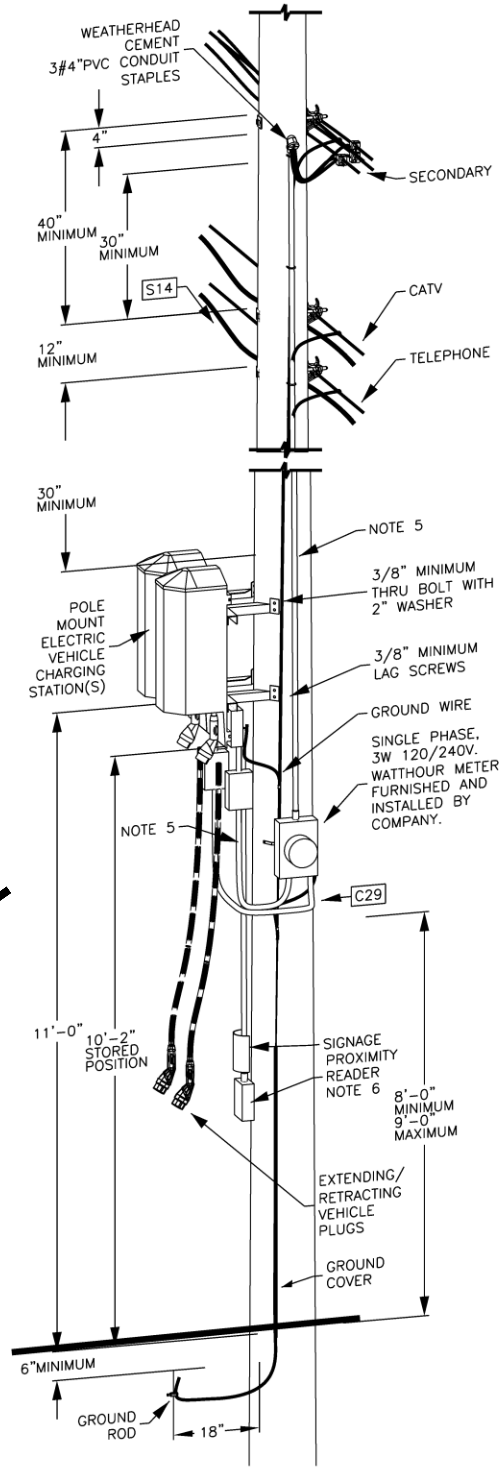
Designer	Drawing	Date
MPR	od17201	3/3/21

7/21 - New bracket to move charging station off pole face.









NOTE:

1. ALL NEW OR REPLACEMENT ELECTRIC VEHICLE CHARGING STATIONS TO BE METERED. INSTALLATIONS SHOULD BE AVOIDED ON POLES WITH OTHER EQUIPMENT. POLES SHALL BE ACCESSIBLE BY BUCKET AND THE PROPOSED INSTALLATION SHALL BE FIELD REVIEWED AND APPROVED BY THE COMPANY AND ANY JOINT POLE OWNERS PRIOR TO WORK.
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6. PROXIMITY READER AND SIGNAGE SHALL BE MOUNTED FLUSH TO POLE TO AVOID MAKING THE POLE READILY CLIMBABLE.

Designer	Drawing	Date
MPR	od17202	3/3/21

DISTRIBUTION WOOD POLE MOUNTED ELECTRIC VEHICLE CHARGING STATION – DUAL CHARGER

Version	Date	Modification	Author(s)	Approval by (Name/Title)
8	7/22	• Corrected drip clearance in 17-105, 17-108, 17-109, 17-109A, 17-118, and17-119.		
7	7/21	• Revised ground clearance dimensions in 17-109A. • Add bracket to move charging station off pole face in 17-201 and 17-202.		
6	7/20	• Revised Space Allocation Table on 17-100 to reflect current agreement with Verizon. • Revised 17-102 to show clearances for streetlight mounted communication equipment. • Added new drawings 17-122 through 17-206 for Smart City applications. • Added new drawings 17-201 and 17-202 for distribution pole mounted electric vehicle chargers.		
5	7/19	• Revised footnotes 2 and 4, and deleted footnote 3 to tables on page 17-100. • Updated Note 3 on 17-103. • Corrected note numbering to match drawings in 17-110 through 17-117.		
4	7/16	• Revised 17.6.30 limits on antenna locations. • Revised antenna clearances and title on drawing 17-109.		
3	7/15	• Revised 17.6.30 limits on antenna locations. • Corrected issue dates on pages 17-109, 17-110, 17-111, 17-112, 17-113, 17-114, 17-115, 17-116, 17-117.		
2	7/12	• Added communication messenger spacing requirement in section 17.4.		
1	07/10	• Revised section 17.7.10 and drawings 17-109 through 17-117 to limit supply space communication cables to agreements made prior to January 1, 2020. • Revised drawing on page 17-102 and associated notes on new page 17-103.		

Supersedes 7/19 Issue – Revised drawings.

Supersedes 7/18 Issue – Revised Drawings

18.0 GENERAL

The following Standard is the practice to be followed when designing and installing single-phase or three-phase risers on the Company's distribution system operating at 35kV and below. This Standard shall apply to primary and secondary single phase or three-phase risers installed by both the Company and/or customers. Further details for primary pole-tops are in Section 9 - Primaries.

All risers shall demonstrate the protective fusing and surge arrester protection as shown on the accompanying construction drawings. Primary dips shall be protected at each end-riser with surge arresters and isolating disconnects. Non-fused disconnects (Std. Item D5) may be used for simple sectionalizing or where over-current protection is better provided elsewhere.

Installations and ownership of customer service laterals and risers generally are the responsibility of the customer and shall be in compliance with Company requirements.

18.1 TERMINATIONS

Supersedes 7/09 Issue - Minor editorial changes.

Exposed cable ends shall never be left unsealed. High voltage applications (above 600V) are provided with terminating kits designed to seal the cable end, increase surface leakage current distance (by use of weathershed skirts), and provide electrical stress relief. Dielectric stress introduced by abrupt separation of the ground-potential shield from the outside of the cable could lead to early failure of the termination.
Low voltage or secondary cables (600V or less) can be sealed while energized with cold-shrink-end caps (Std. Item UC90).

Any de-energized cable, whether it is still on the reel in the yard or recently installed and awaiting terminations, shall have cold-shrink end caps applied to all exposed cable ends. Tape wraps are not adequate for sealing out moisture.

Final termination assembly should be kept relatively straight and as vertical as practical. Rain shield skirts should never be oriented more than 45 degrees from a vertical orientation. The cable should first be trained into final position before application of the termination kit to minimize subsequent bending stress on the termination/connector assembly. All cables shall be tagged.

Terminations for #2 underground cables shall consist of a bayonet, or pin, style compression connection where bolted vise connectors are utilized to secure arrester and tap leads located within the appropriate animal guard (refer to Page 18-104 for details).

Terminations for underground cables larger than #2 shall utilize NEMA pad style compression connections where arrester and tap leads are secured using the appropriate size primary connection as outlined in Section 5 - Connectors (refer to Page 18-107 for details).

Refer to Page 18-104 for termination and concentric neutral connection and wiring detail for #2 underground riser cables and Page 18-107 for underground riser cables that are larger than #2. Further termination detail can be found in Section 37 - Terminations in the Underground Construction Standards manual.

18.2 CABLES

The following cables are standard for all normal in-conduit or direct burial 15-35 kV underground circuits. Detailed descriptions of these and other underground cables are shown in Section 35 - Cables in the Underground Construction Standards manual.

Table 1
Standard Primary Conductors

Voltage (kV)	Conductor	Packaging	Std. Item
15	#2 AL	3-1/C Parallel	UC11BJ
15	#2 CU	1-1/C	UC11BK
15	#2 CU	3-1/C Parallel	UC11BL
15	#4/0 CU	3-1/C Parallel	UC11E
15	350 CU	3-1/C Parallel	UC12F
15	500 AL	3-1/C Parallel	UC12GG
15	500 CU	3-1/C Parallel	UC17
15	750 AL	3-1/C Parallel	UC12HG
15	1000 AL	3-1/C Parallel	UC12TA
15	1000 AL	1-1/C	UC12TB
15	1000 CU	3-1/C Parallel	UC12TC
25	#1/0 CU	3-1/C Parallel	UC23CJ
25	#4/0 CU	3-1/C Parallel	UC23EC
25	350 AL	3-1/C Parallel	UC23FA
25	350 CU	3-1/C Parallel	UC23FJ
25	500 AL	3-1/C Parallel	UC23GA
25	500 CU	3-1/C Parallel	UC23GJ
25	1000 CU	3-1/C Parallel	UC23TC
25	1000 AL	3-1/C Parallel	UC23TA
35	#1/0 AL	1-1/C	UC35C1
35	#1/0 AL	3-1/C Parallel	UC35C3
35	#2/0 CU	3-1/C Parallel	UC35DJ
35	500 CU	3-1/C Parallel	UC35GJ
35	750 CU	3-1/C Parallel	UC35HJ
35	1000 CU	3-1/C Parallel	UC35TC
35	1000 AL	3-1/C Parallel	UC35TJ

Supersedes 7/11 Issue - Edited termination labeling requirement (Section 18.2.20).

18.2.10 Cable Ampacity

Allowable ampacity varies widely due to different cable arrangements. Ampacity is affected by the proximity and loading of adjacent circuits, ambient temperatures, etc. Contact Standards Engineering for ampacity ratings of circuits as necessary.

18.2.20 Cable Identification Tags

Primary riser terminations shall be labeled in accordance with Section 35.16.10 (Terminations). Secondary riser terminations shall be labeled in accordance with Section 35.16.20 (Including secondary services at pole end served from overhead transformers). See Tag Holder location on Std 18-109 and Std 18-110.

18.2.30 Phase and Feeder Numbering

Phase and feeder identification, when requested, is shown on Drawing 2-112 in Section 2-Poles. For new construction, the first pole out of a substation shall always include phase markings. Prior to any work on multi-phase lines, phase identification shall always be confirmed with proper testing equipment (e.g. phase tester).

18.3 ARRESTERS

Arresters at locations other than the cable termination point do not adequately protect the cable. One significant variable under user control is total connection lead length. This is comprised of the line lead length and the ground lead length. Line lead length is the distance from the phase conductor tap to the line terminal of the arrester. The ground lead length is the distance that the surge current flows from the arrester ground to the common ground/neutral connection with the cable metallic shield. By keeping the total connection lead length as short as possible, the total impressed transient voltage developed by the arrester installation is minimized. A minimum margin of protection greater than or equal to 20% is required for sufficient protection. Additionally, riser type surge arresters denoted with a yellow band are required for all riser pole applications.

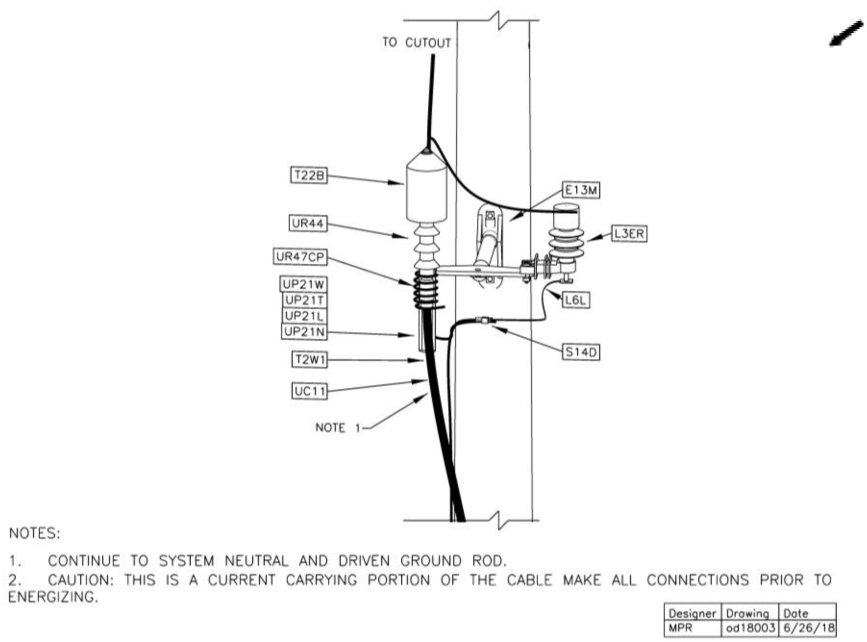

Figure 1 - Grounding for riser arresters.

Supersedes 7/16 Issue – 3D Drawing Conversion

18.4 ANIMAL GUARDS

Animal guards shall be installed on all riser pole terminators to protect terminations from incidental flashover. The guard shall be placed over the top skirt of the termination.

18.5 RISER GUARDS

Vertical electrical supply conductors on riser poles shall be protected by a covering that gives suitable mechanical protection to a minimum of 4 inches above secondary cables for primary risers, and a minimum of 40 inches above communication cables for a secondary riser. For primary risers, the first 8 feet above ground shall be galvanized steel. The remainder shall be either u-duct or Schedule 40 PVC conduit. For secondary risers, Schedule 80 PVC conduit may be used as an alternate for the first 8 feet above ground. Secure conduit with galvanized steel straps located at 30” intervals. The remaining cable covering shall be either u-duct or Schedule 40 PVC conduit.

Risers built to the old direct buried standard did not require a metallic sweep and a metallic conduit the first 8 feet up the pole. When maintenance is performed on these risers and the pole does not require replacement a galvanized steel U duct (Std. Item UK12) shall replace the existing plastic U duct and a bond clamp (Std. Item UK39) shall be used to ground the metallic U duct.

Risers should be located on the pole in the safest available position with respect to climbing space and exposure to traffic damage (NESC Rule 362-A).

To prevent induction heating, all 3 cables of a three-phase circuit shall be installed in a single galvanized steel conduit. Where a galvanized steel conduit is used, it shall be bonded to the down ground as shown in Figure 2. This connection shall be made utilizing a compression connector. All spare galvanized steel riser pipes shall be bonded in the same manner. Locations where threaded grounding bushings are used at end of metallic conduit and u-duct will not fit over bushings, a riser reducer guard (Std. Item UK14GF) shall be installed to cover conduit and cables.

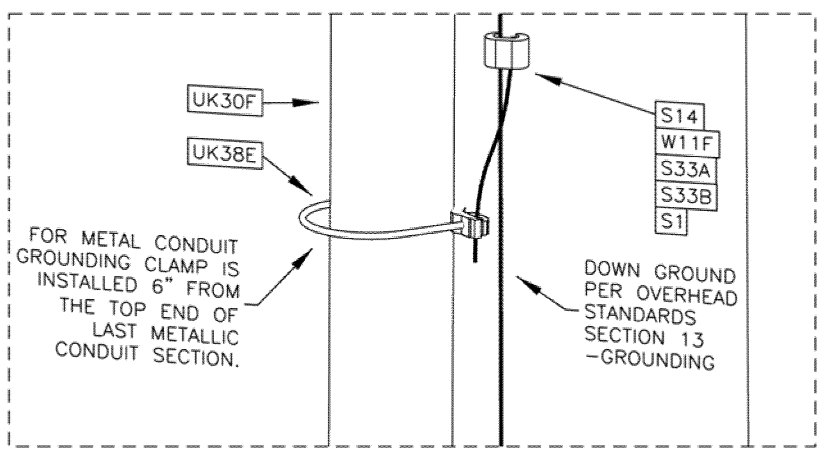

FIGURE 2 – GROUNDING DETAIL FOR GALVANIZED STEEL RISER CONDUIT

Designer	Drawing	Date
MPR	od18004	1/10/20

Figure 2 - Grounding detail for galvanized steel riser conduit.

Drawing 18-112 displays an alternate riser construction using conduit standoff brackets. This construction can be used where the riser will not interfere with pedestrian or vehicular traffic. Using conduit standoff brackets allows for easier pole climbing and easier pole replacement. U-guard (Std. Item UK11) shall be used at riser locations above the specified 8 foot minimum section of conduit to the point of secondary/neutral bracket installation where conduit (schedule 80 PVC or galvanized steel) is not used to cover the riser cables to the point of secondary/neutral bracket installation.

Supersedes 7/18 Issue – Corrected reference to compression connector Std Item S14

18.6 CONDUIT SEALING

All conduits used for risers and all spare riser pipes shall be sealed to prevent water from entering the conduit. Use Std. Item UF10 to seal all riser conduits at the top of the last piece of conduit used. This UV-resistant expanding foam can be applied in temperatures ranging from 41˚F to 95˚F and can withstand temperatures as low as -22˚F and as high as 176˚F after it has cured. The foam should be stored in a warm environment before applying as the foam tends to become clogged in the nozzle if kept in cooler storage areas. **Do not** use Std Item UF20 to seal riser conduits. UF20 is for fire sealing conduits in manholes and does not contain a UV inhibitor.

Supersedes 7/09 Issue - Added clarification on which foam to use for riser conduit sealing.

18.7 RISER ACCESSIBILITY

When constructing risers in backyards or other locations where the riser is not accessible by bucket truck, the riser shall be built so that it is easily climbable. Use of conduit standoff brackets (see Drawing 18-112 for details) are strongly recommended in these situations.

18.8 RAISING TERMINATIONS ON A POLE

This may be done to accommodate new attachments on a pole, to increase ground clearance of lines or when relocating a pole. This work may include replacing a pole with a taller pole or rearranging facilities on an existing pole.

18.8.10 Primary Cable in Conduit

Single phase and three phase #2 cable can be spliced on the pole. Splices must be located above the 8' galvanized steel conduit and shall be staggered if 3 phases are being spliced such that all of the splices are completely covered by the riser guard (u-duct). If the riser is located at the bottom of a hill where water in the conduit is an issue, install a pull box at the base of the riser to allow water to drain (see alternate detail on most riser construction drawings).

For cables larger than #2, the cable shall be replaced from the first existing access point away from the pole (padmounted switchgear, handhole/manhole, pull box, etc.).

18.8.20 Direct Buried Primary Cable

When the primary underground cable away from the pole is direct buried, replacing the cable from the pole to an existing access point requires excavation. A galvanized steel sweep and riser pipe are required for all risers; install these items when relocating terminations on the pole if they were not previously installed. To minimize the required excavation either:

A. Direct bury the splices:
Splice the new cables to the existing cables near the base of the pole beyond the underground end of the riser sweep pipe, or

B. Install a new handhole or pull box:
Install a new handhole or pull box at the underground end of the riser sweep pipe near the base of the pole along the route of the existing cable and splice the new cables to the existing cables at the handhole or pull box. Install new riser and terminations at the new primary level on the pole. Refer to Standards Section 33.0.10 to select the appropriate handhole or pull box for the location, voltage, and cable size.

18.8.30 Secondary Risers

Secondary cables may be spliced on the pole to allow secondary riser connections to be raised on a pole. Splice the new cable to the existing cable using underground splices. Stagger the individual splices on the pole so they will fit under the u-guard. Install the splices below communication wires and at least 8 feet above ground. Install new connections at the new secondary level on the pole.

18.8.40 Cost Allocation

Refer to the applicable tariff for cost assignment(s) for the state in which the work will be performed (in Upstate NY, refer to ESB 750 for cost allocation guidelines).

If there are no tariff restrictions, the Company will perform this work and either: (i) the Company is responsible for the costs of the work or (ii) the Customer is responsible for the costs of the work, or (iii) the costs of the work may be paid by a third party as part of a reimbursable project (e.g. reimbursable highway project, third party attachment make-ready, etc.).

18.9 RISERS IN SUBSTATIONS

In general, design of substation facilities is the responsibility of the substation engineering group. However, the installation of cable risers inside substations shall comply with the requirements of Underground Distribution Standards with regards to cable terminations, lightning protection, grounding and cable support.

Refer to drawing 18-370.

Supersedes 7/12 Issue: Text edit 18.9.

18.9.10 Terminations

All terminations are to be cold shrink type, standard item UR44_ or UR45_. Lugs shall be standard item UL15_ for copper conductor and standard item UL16_ for aluminum. Do not substitute other lugs as these may not be sealed to prevent water intrusion into the conductor strands. Install an animal guard, standard item T22B on the termination. For additional information, see Section 37 of the Underground Construction Standards.

18.9.20 Lightning Arresters

A riser class lightning arrester, standard item UL3_, shall be mounted immediately adjacent to each cable termination. Install a flex ground lead, standard item L6 or L6L, from the ground terminal to station ground bus. Use #2 soft drawn, covered lead wire, standard item W13E to connect the arrester to the phase. Both the phase lead and the ground lead should be as short as possible for the best cable insulation protection.

18.9.30 Grounding

The concentric neutral from each phase termination is to be connected to the 4/0 copper ground bus. The ground bus should be connected to the below grade ground grid in a minimum of 2 places. For optimal cable insulation protection, connect the concentric neutral and the arrester ground lead to the station ground bus using a single connector, standard item S14J. If the concentric neutral leads need to be extended, see Table 2 in Section 37 of the Underground Construction Standards.

7/14 New Bullet 18.10

18.9.40 Cable Support

Install cable positioners to support the weight of the cable. Install a minimum of 1 positioner a maximum of 2” below the bottom of the termination. Install additional positioners such located so that the maximum distance from grade to the first positioner is less than 10’ and the distance between positioners does not exceed 7’. These positioners are necessary to prevent excessive cable movement during fault current events which can put undue stress on the connection points. Do not use the lug to support the weight of the cable.

18.9.50 Riser Conduit

Install a fairleader, standard item UK49B, to protect the cable from damage due to contact with the edge of the conduit. Fill the space between the fairleader and the cable with expanding foam, standard item UF10. For metallic riser conduit, install a grounding clamp, standard item UK38_ and connect it to the station ground grid with 4/0 copper wire, standard item W19G.

18.9.60 Bus Supports

The maximum distance between the terminal lug on the top of the terminator and the first support for the station bus is 5’. This maximum distance is required to prevent undue forces from being imposed on the terminal lug / cable during high current faults. If the distance to the first bus support exceeds 5’, install additional supports as needed.

18.9.70 Minimum Approach Distance

The first disconnecting means above the cable termination must be sufficiently far from the termination to allow connection / disconnection of the termination without violating the minimum approach distance as stated in the Safety Manual. This clearance will also be required to cable testing and maintenance. To determine the appropriate distance, add 3’6” to the minimum approach distance as stated in the safety manual for the circuit voltage.

18.10 RISER CONDUIT DRAINAGE

Primary cables in conduit risers located at a lower grade (level) may require the installation of a pullbox (Item UR6) to drain away water run-off from equipment and conduit located at a higher grade. We want to avoid water settling at conduit sweeps located on riser poles and that could freeze up with very low temperatures thus damaging the primary cable inside conduit. An “Alternate Detail” drawing is provided in Standard 18-124 for these lower grade riser pole cases. Consult with Standards Engineering if needed.

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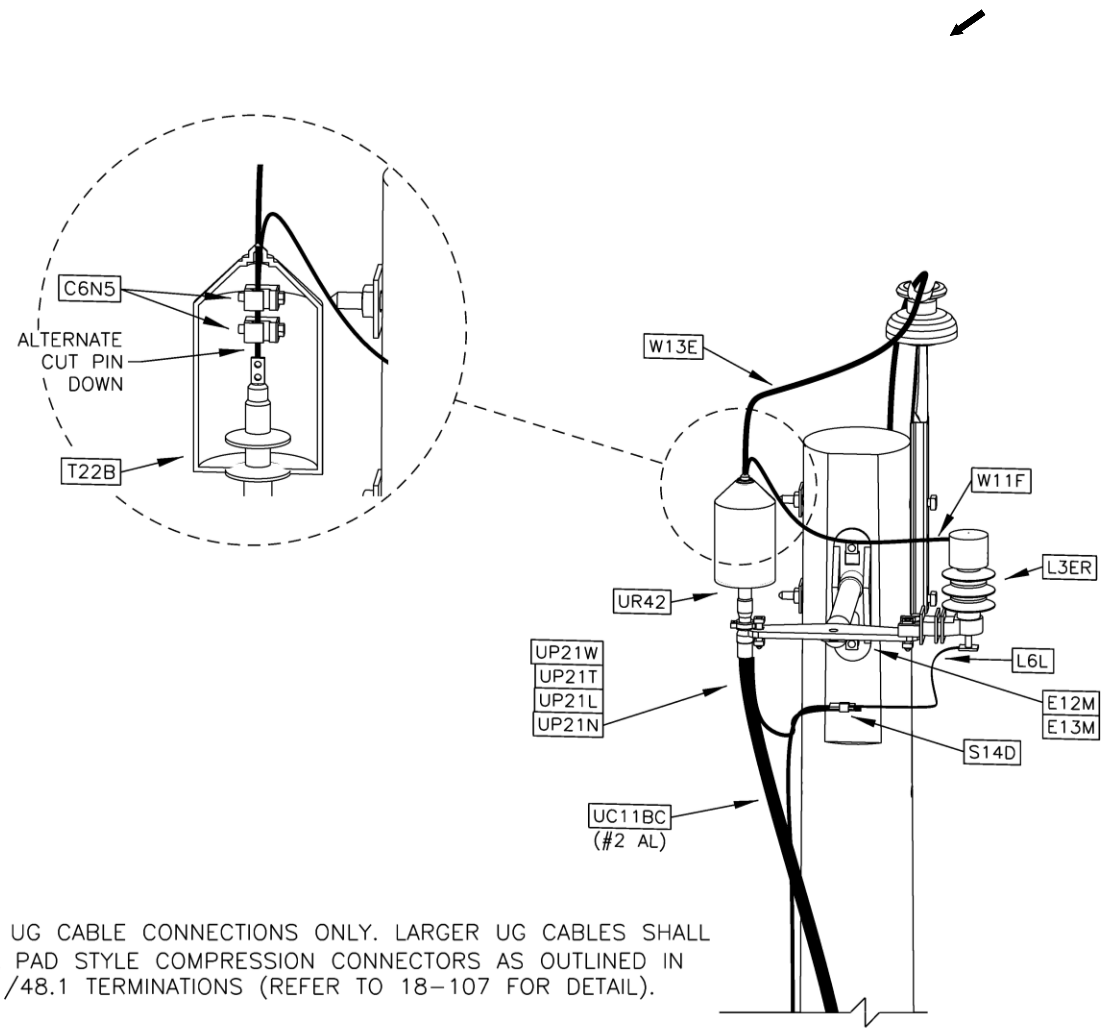
CU = CCSCT15K2R	Cold Shrink Cable Termination 15kV #2AL 1PH Riser
CU = PE12M	Equipment Mount Fiberglass 3PH
CU = PE13M	Equipment Mount Fiberglass 1PH
CU = CAL(X)KRPNE	Arrester Lightning (X)kV UG Riser MOV (X) = Voltage Rating

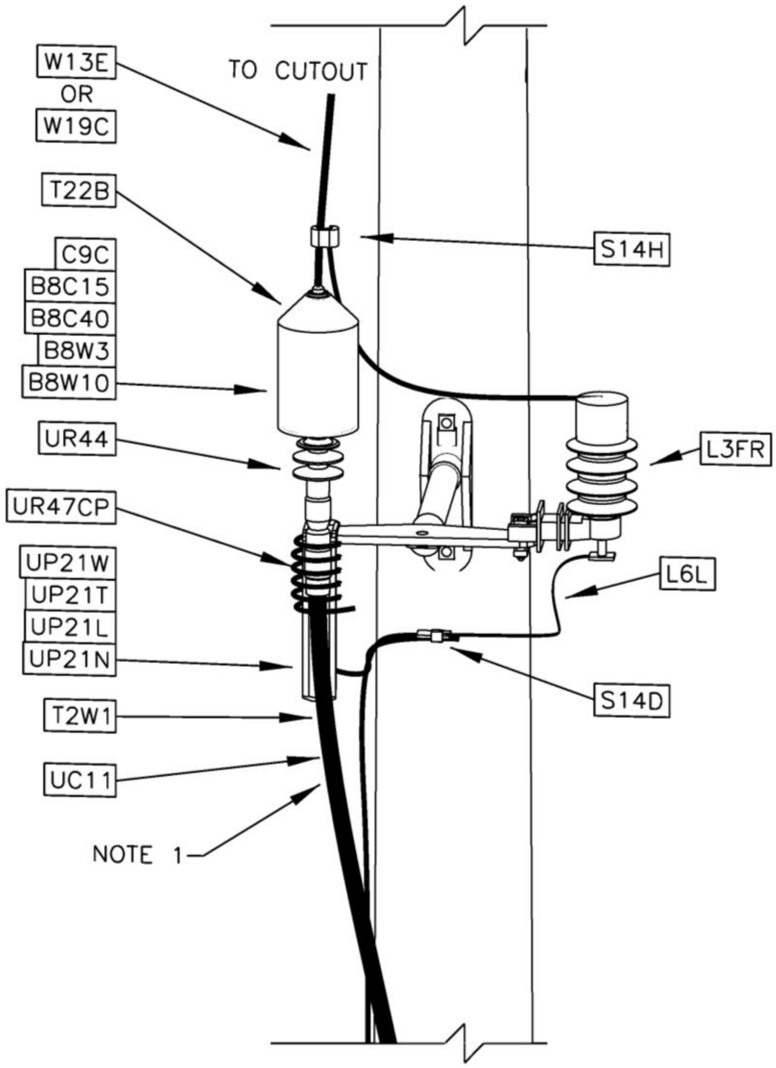


NOTE:
1. FOR #2 UG CABLE CONNECTIONS ONLY. LARGER UG CABLES SHALL UTILIZE NEMA PAD STYLE COMPRESSION CONNECTORS AS OUTLINED IN SECTION 18.1/48.1 TERMINATIONS (REFER TO 18-107 FOR DETAIL).

Designer	Drawing	Date
MPR	od18104	6/26/18

Supersedes 7/16– 3D Drawing Conversion.

CU = CCSCT(X)K(Y)R	Cold Shrink Cable Termination (X)kV (Y) Riser, (X) =Voltage Rating, (Y) = Cable Size
CU = CCSCT35K1/0ARNE	Cold Shrink Cable Termination 35kV 1/0AL Riser 1Ph
CU = PE12M	Equipment Mount Fiberglass 3PH
CU = PE13M	Equipment Mount Fiberglass 1PH
CU = CAL(X)KRPNE	Arrester Lightning (X)kV UG Riser MOV (X) = Voltage Rating



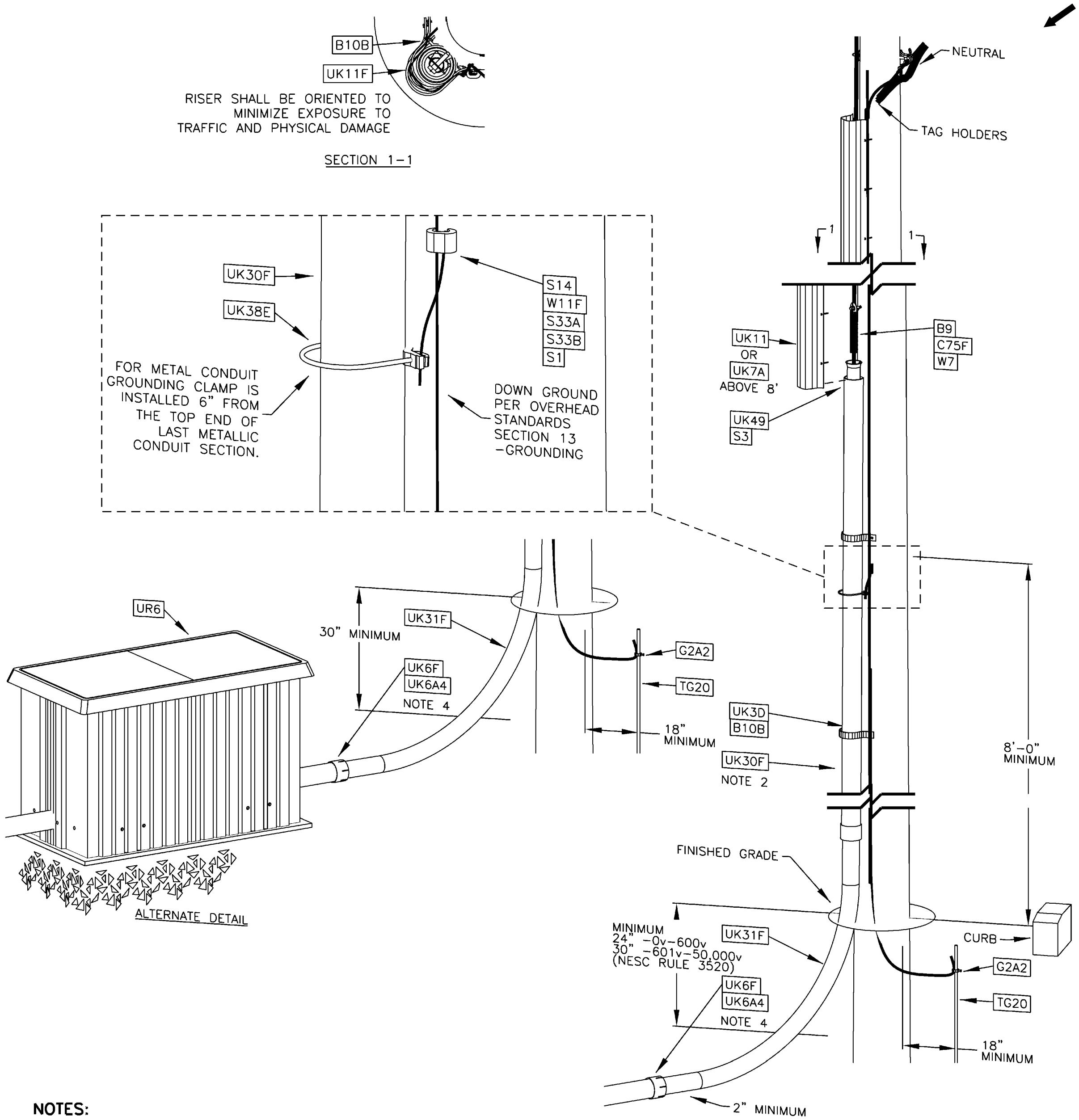
Supersedes 7/11 -3D Drawing Conversion

NOTE:
1. REFER TO DRAWING 5-148 FOR TERMINAL CONNECTOR INSTALLATION NOTES.

Designer	Drawing	Date
MPR	od18107	6/26/18

CU = SER-UG-OH,(X)PH-SEC,(Y)A	Service UG to OH, (X) Phase, to Sec, (Y) Amp, (X) = 1 or 3, (Y) = 200, 400
CU = SER-UG-OH,(X)PH-TRANS,(Y)A	Service UG to OH, (X) Phase, to Transformer, (Y) Amp, (X) = 1 or 3, (Y) = 200, 400, 800
CU=SER-UG-OH, (X)PH,(Y)A,CST	Service UG to OH, (X) Phase to Sec, (Y)Amp, (X)=1 or 3 (Y) = 200 Coastal

Supersedes 7/18 – Corrected reference to compression connector Std Item S14



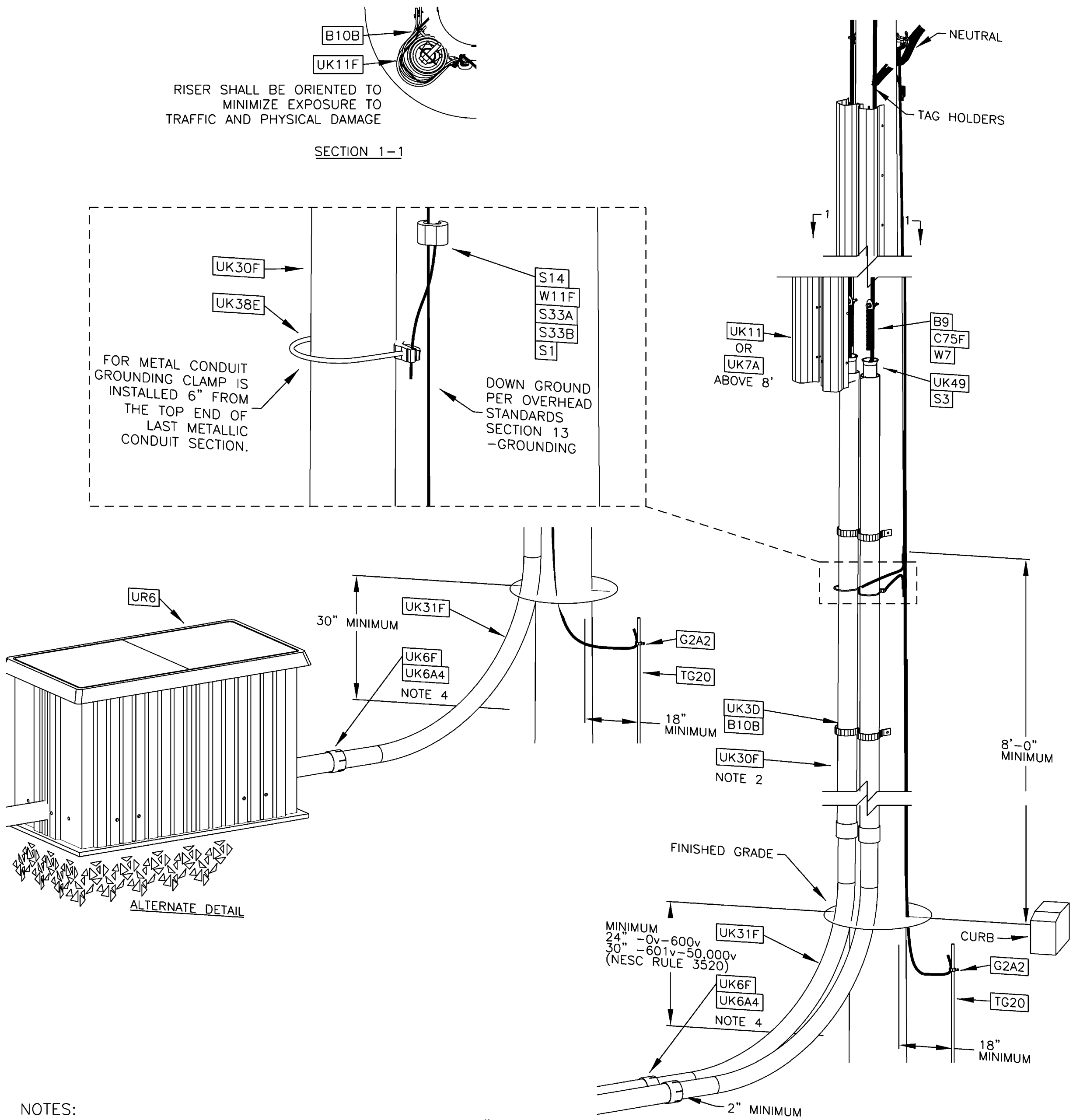
NOTES:

1. INSTALL RISER GUARD SECTIONS BELL-END DOWN.
2. THE SERVICE LATERAL CABLE, CONDUIT, GROUND CLAMP AND SHORT SECTION OF GROUNDING CONDUCTOR SHALL BE FURNISHED BY THE CUSTOMER. NATIONAL GRID WILL INSTALL GROUND ROD AND COMPLETE BONDING REQUIREMENTS.
3. IF THE ENDS OF THE CUSTOMER OWNED SERVICE LATERAL CABLES ARE WITHOUT SUITABLE MOISTURE PREVENTING SEALS,(RUBBER CAPS OR TAPE) DO NOT ATTACH. NOTIFY SUPERVISOR IMMEDIATELY.
4. OMIT CONDUIT ON DIRECT BURIED INSTALLATIONS AND INSTALL A LEADER GUARD (UK49) IN PLACE OF THE CONDUIT ADAPTER (UK6F).
5. TO PREVENT INDUCTION HEATING OF THE METALLIC CONDUIT DO NOT SEPARATE THE PHASE CONDUCTORS OF A THREE PHASE CIRCUIT INTO SEPARATE CONDUITS.
6. ON POLES NOT ACCESSIBLE BY BUCKET TRUCK, "THE NUMBER, SIZE, AND LOCATION OF RISER DUCTS OR GUARDS SHALL BE LIMITED TO ALLOW ADEQUATE ACCESS FOR CLIMBING", NESC RULE 362B.

Designer	Drawing	Date
MPR	od18109	1/16/20

TYPICAL SINGLE OR THREE PHASE SECONDARY RISER DETAILS FOR SINGLE RISER PIPE INSTALLATION			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 18-109	ISSUE 7/20

SEE PAGE 18-109 FOR CUS



NOTES:

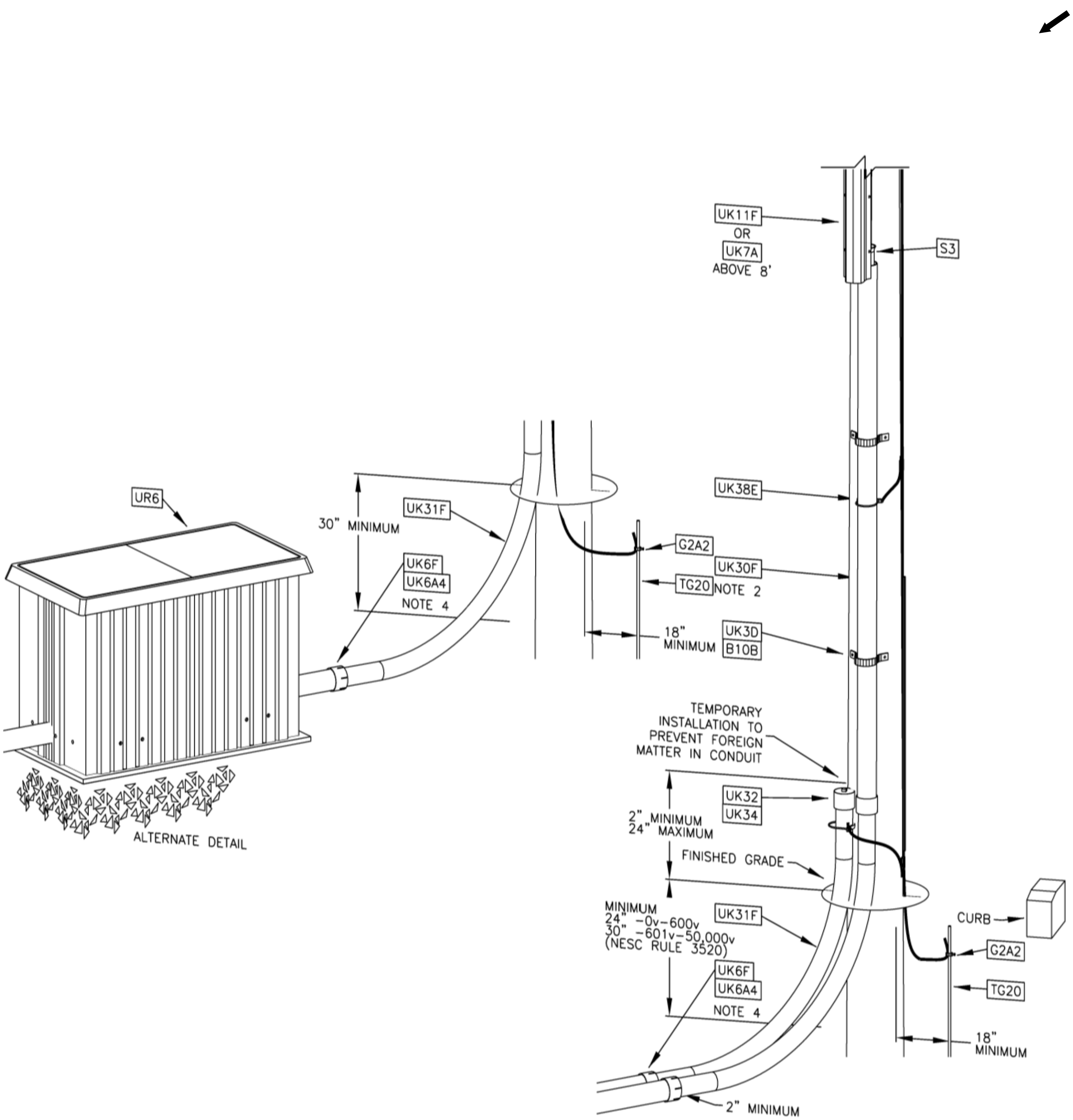
1. ON POLES NOT ACCESSIBLE BY BUCKET TRUCK, "THE NUMBER, SIZE, AND LOCATION OF RISER DUCTS OR GUARDS SHALL BE LIMITED TO ALLOW ADEQUATE ACCESS FOR CLIMBING", NESC RULE 362B.
2. THE SERVICE LATERAL CABLE, CONDUIT, GROUND CLAMP AND SHORT SECTION OF GROUNDING CONDUCTOR SHALL BE FURNISHED BY THE CUSTOMER. NATIONAL GRID WILL INSTALL GROUND ROD AND COMPLETE BONDING REQUIREMENTS.
3. IF THE ENDS OF THE CUSTOMER OWNED SERVICE LATERAL CABLES ARE WITHOUT SUITABLE MOISTURE PREVENTING SEALS,(RUBBER CAPS OR TAPE) DO NOT ATTACH. NOTIFY SUPERVISOR IMMEDIATELY.
4. OMIT CONDUIT ON DIRECT BURIED INSTALLATIONS AND INSTALL A LEADER GUARD (UK49) IN PLACE OF THE CONDUIT ADAPTER (UK6F).
5. TO PREVENT INDUCTION HEATING OF THE METALLIC CONDUIT DO NOT SEPARATE THE PHASE CONDUCTORS OF A THREE PHASE CIRCUIT INTO SEPARATE CONDUITS.
6. MAY PUT RISERS OF DIFFERENT VOLTAGES ON THE SAME POLE.

Designer	Drawing	Date
MPR	od18110	1/22/20

Supersedes 7/18 – Corrected reference to compression connector Std Item S14

TYPICAL SINGLE OR THREE PHASE SECONDARY RISER DETAILS FOR MULTIPLE RISER PIPE INSTALLATIONS

CU – RISERSPARESWEEP(X)IN	(X) = 2 or 3 or 4 or 5 or 6

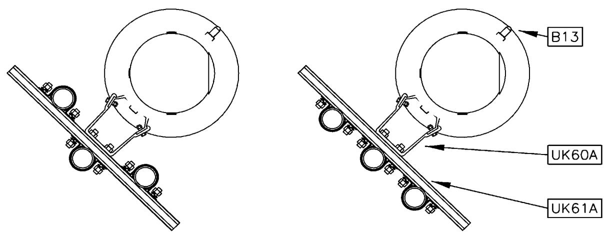


Designer	Drawing	Date
MPR	od18111	6/26/18

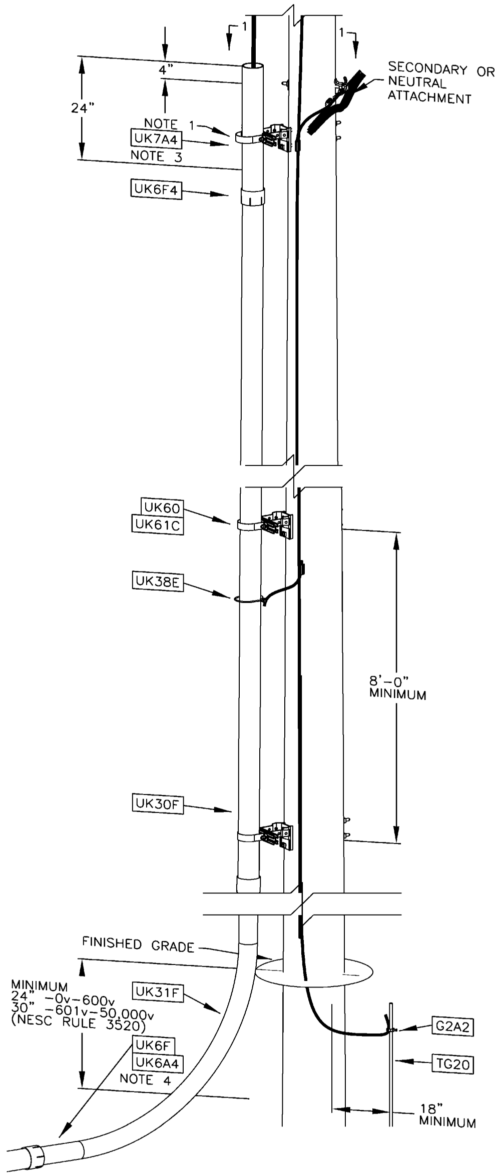
Supersedes 7/13– 3D Drawing Conversion

CU = RCSBUK60	Riser Conduit Standoff Bracket Pole Mount
CU = RCSK(X)(Y)	Riser Conduit Strap Kits (X) = Std. ID, (Y) = Conduit Size

TYPICAL CONDUIT STANDOFFBRACKET INSTALLATIONS



RISER SHALL BE ORIENTED TO MINIMIZE EXPOSER TO TRAFFIC AND PHYSICAL DAMAGE



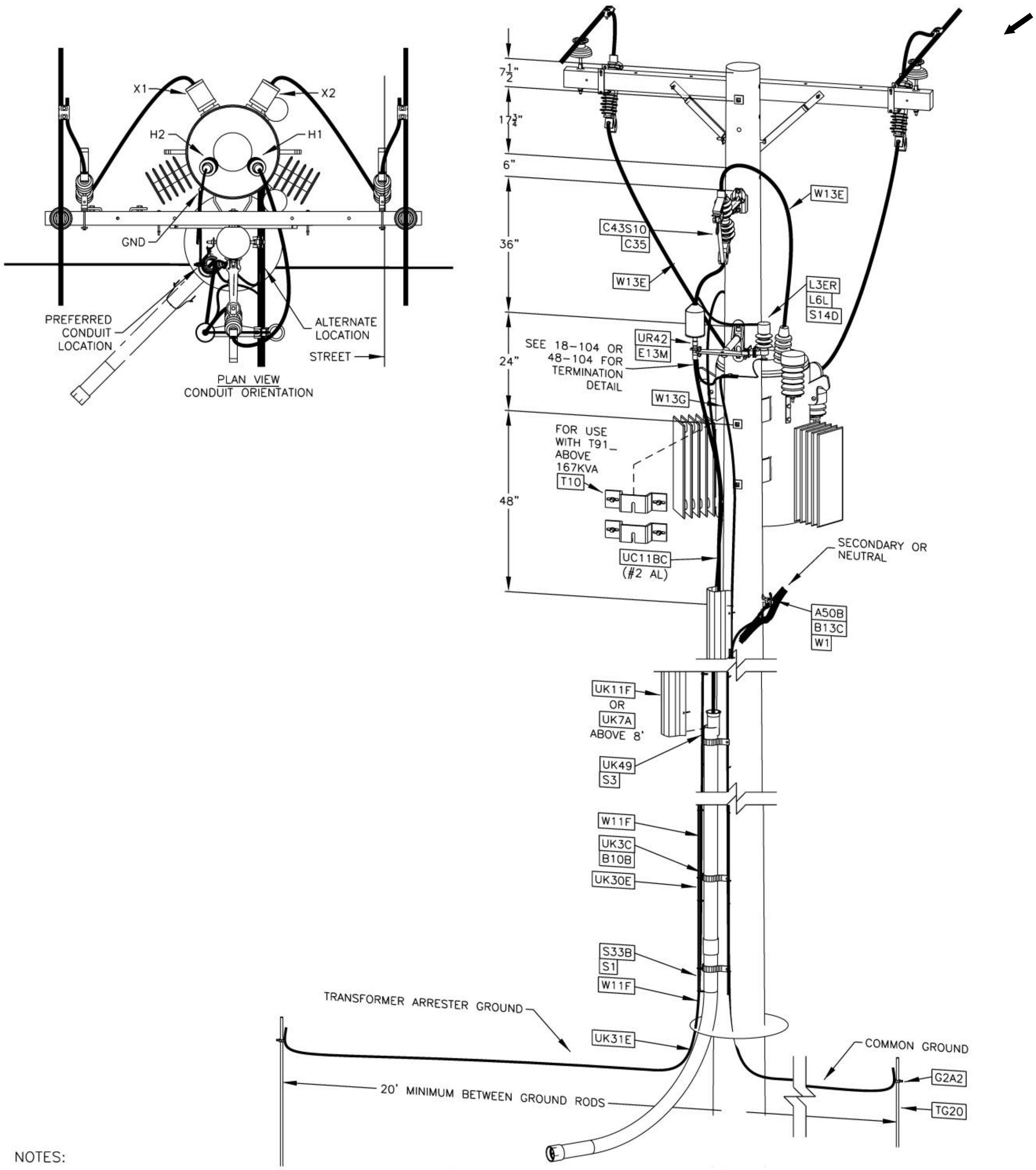
NOTES:
1. INSTALL THE INTERMEDIATE STANDOFF BRACKET EQUIDISTANT FROM THE UPPER AND LOWER BRACKETS.
2. RISER PIPES SHALL BE BONDED TO THE DOWN GROUND - SEE 18-111/48-111 FOR DETAILS.
3. SECONDARY SERVICES REQUIRE ELECTRICIANS TO INSTALL THE FIRST 10' OF CONDUIT UP THE POLE. NATIONAL GRID CREWS INSTALL STAND OFF BRACKETS AND 2'-10" SECTIONS OF THE PVC CONDUIT AT TOP.
4. THIS INSTALLATION CAN BE USED FOR PRIMARY RISERS. CONSULT WITH STANDARDS ENGINEERING.

Designer	Drawing	Date
MPR	od18112	12/10/18

Supersedes 7/18- Revised Drawing, conduit strap above sweep

RISER MU = @18-125CC(Y)K(I)(X)	Single Phase Riser, (Y) Insulation Rating, (I) Cutout Body Size, (X) Fuse Type, In Riser Guard
RISER MU = @18-125CC(Y)K(I)(X)C	Single Phase Riser, (Y) Insulation Rating, (I) Cutout Body Size, (X) Fuse Type, In Conduit
RATIO MU = @(W)K(X)P(Y)S(Z)T1PSU(A)(B)	(W) kVA Size, (X) Pri Code, (Y) Sec Code, (Z) Tap Code, 1 Phase, (A) Source Voltage, (B) Load Voltage

Supersedes 7/14- 3D Drawing Conversion



NOTES:

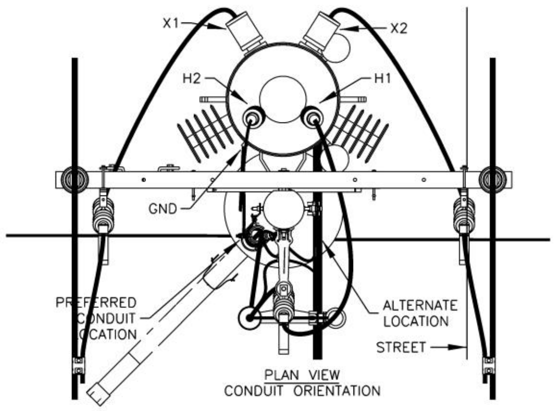
1. REMOVE HIGH-SIDE ARRESTERS ON TRANSFORMER (AT H1 AND IF ONE EXISTS AT H2). CONNECT H2, CONCENTRIC NEUTRAL AND RISER ARRESTER LEAD TO THE COMMON GROUND.
2. CONNECT THE LOW-SIDE ARRESTERS ON THE TRANSFORMER (AT X1 AND X2) AND THE TANK GROUND TO THE SEPARATE TRANSFORMER GROUND.
3. DO NOT CONNECT TRANSFORMER ARRESTER GROUND TO THE SECONDARY/NEUTRAL.

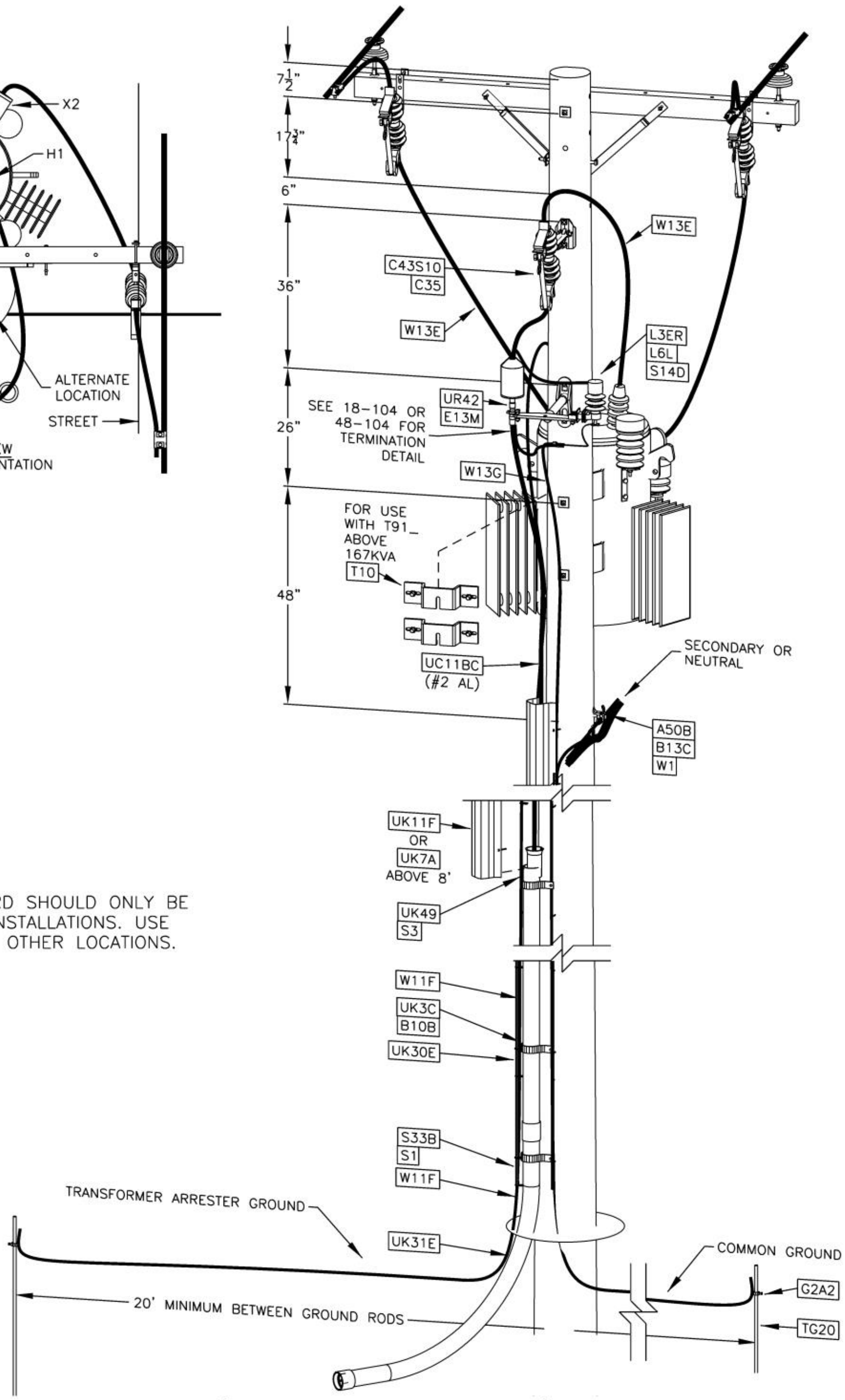
Designer	Drawing	Date
MPR	od18115	6/26/18

SINGLE PHASE STEP-UP 5 kV DELTA X 15 kV WYE
TRANSFORMER INSTALLATION AND SINGLE CABLE RISER

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	18-115	7/18

RISER MU = @18-125CC(Y)K(I)(X)	Single Phase Riser, (Y) Insulation Rating, (I) Cutout Body Size, (X) Fuse Type, In Riser Guard
RISER MU = @18-125CC(Y)K(I)(X)C	Single Phase Riser, (Y) Insulation Rating, (I) Cutout Body Size, (X) Fuse Type, In Conduit
RATIO MU = @(W)K(X)P(Y)S(Z)T1PSU(A)(B)	(W) kVA Size, (X) Pri Code, (Y) Sec Code, (Z) Tap Code, 1 Phase, (A) Source Voltage, (B) Load Voltage





IMPORTANT: THIS STANDARD SHOULD ONLY BE USED FOR BACKYARD INSTALLATIONS. USE STANDARD 18-115 FOR OTHER LOCATIONS.

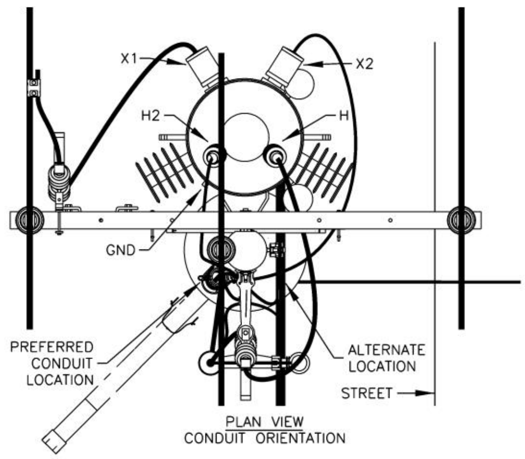
NOTES:

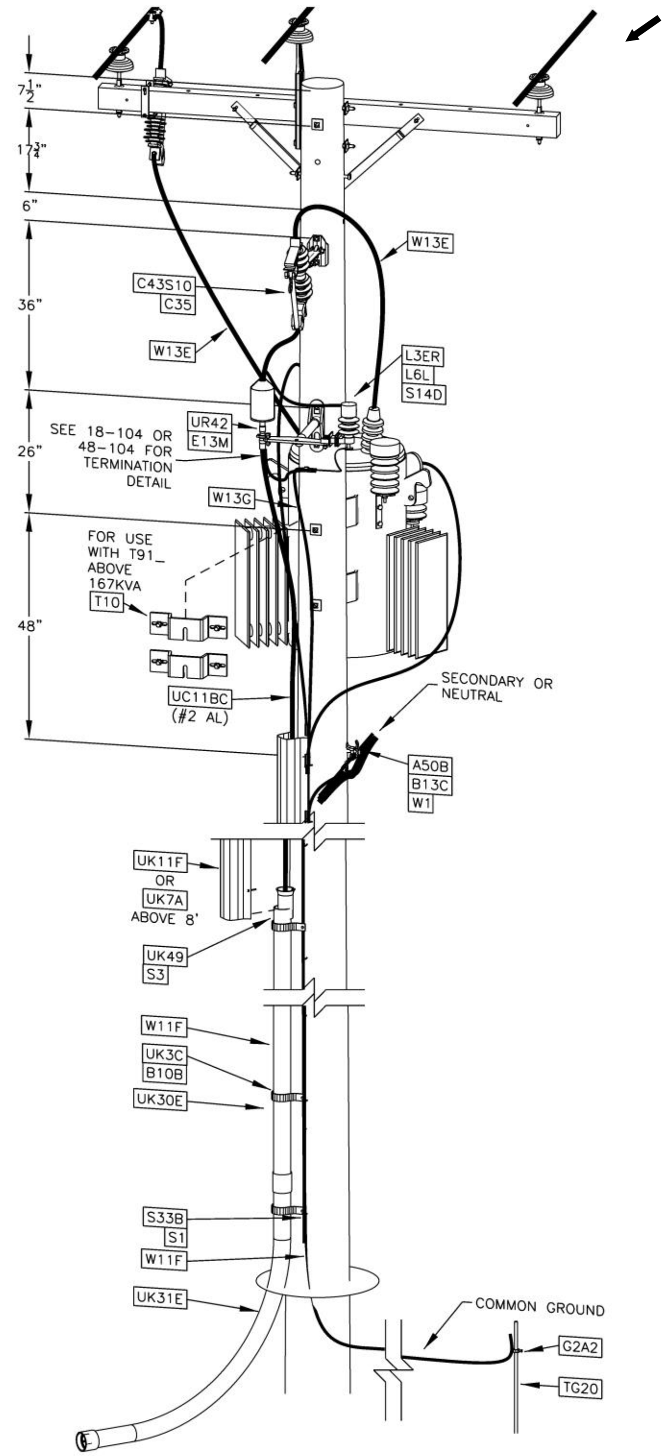
1. REMOVE HIGH-SIDE ARRESTERS ON TRANSFORMER (AT H1 AND IF ONE EXISTS AT H2). CONNECT H2, CONCENTRIC NEUTRAL AND RISER ARRESTER LEAD TO THE COMMON GROUND.
2. CONNECT THE LOW-SIDE ARRESTERS ON THE TRANSFORMER (AT X1 AND X2) AND THE TANK GROUND TO THE SEPARATE TRANSFORMER GROUND.
3. DO NOT CONNECT TRANSFORMER ARRESTER GROUND TO THE SECONDARY/NEUTRAL.

Designer	Drawing	Date
MPR	od18115B	6/26/18

Supersedes 7/16 Issue – 3D Drawing Conversion

Supersedes 7/11- 3D Drawing Conversion





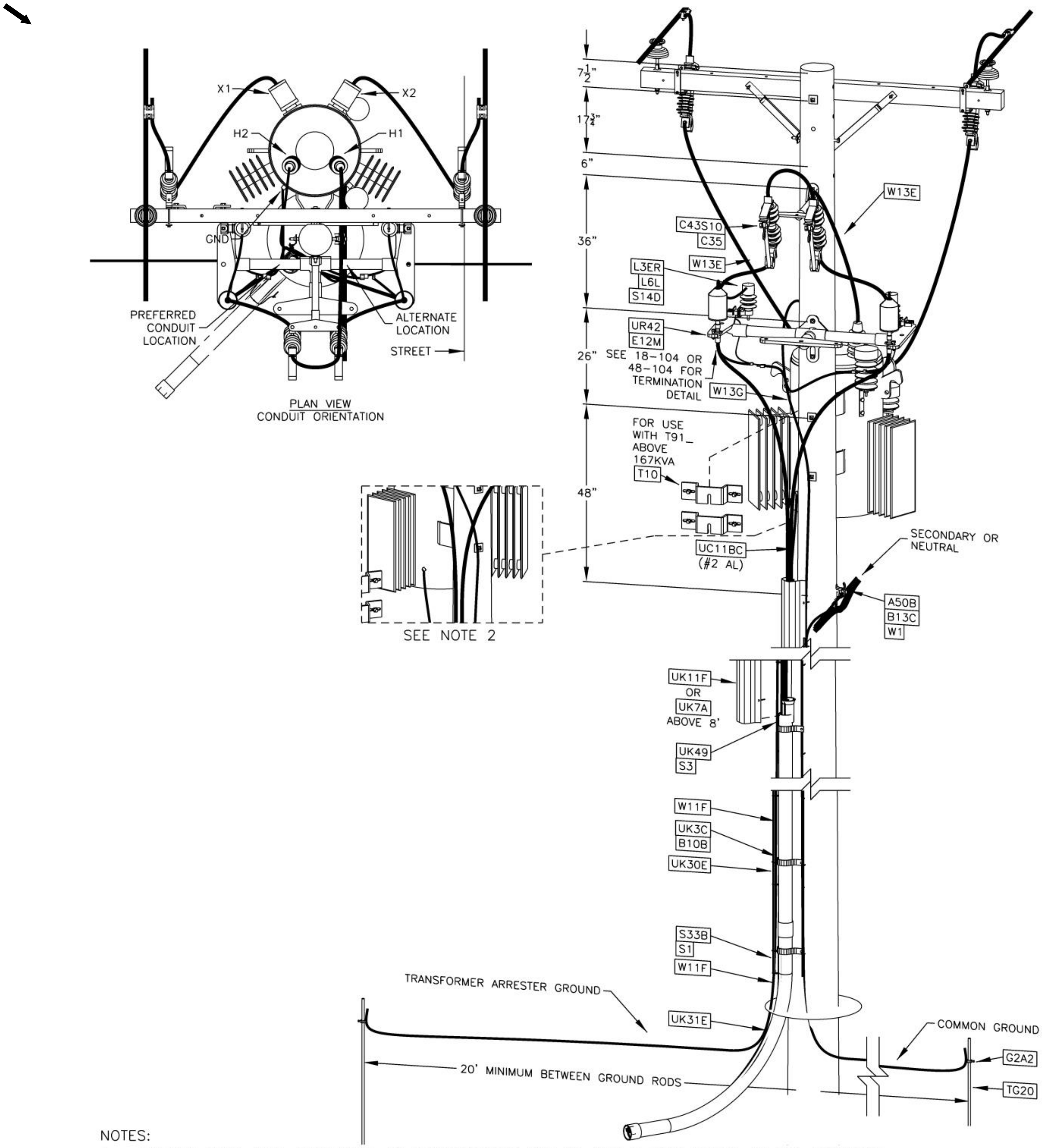
NOTES:

CONTINUE CONCENTRIC NEUTRAL TO SYSTEM NEUTRAL USING A CONDUCTOR OF EQUIVALENT SIZE TO THE UNDERGROUND CABLE CONCENTRIC NEUTRAL (I.E. #2 OR 2/0).

Designer	Drawing	Date
MPR	od18116	6/26/18

SINGLE PHASE STEP-UP 5 kV WYE X 15 kV WYE
TRANSFORMER INSTALLATION AND CABLE RISER

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	18-116	7/18



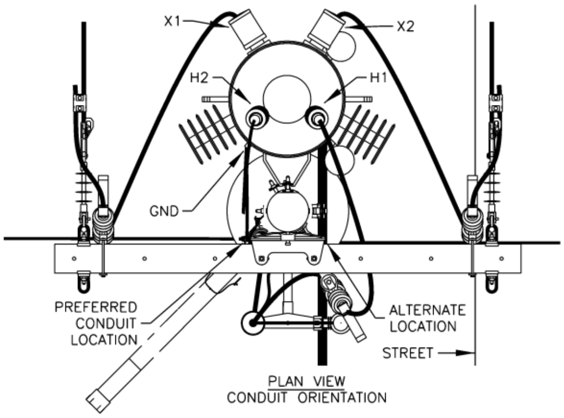
Supersedes 7/18– Title update.

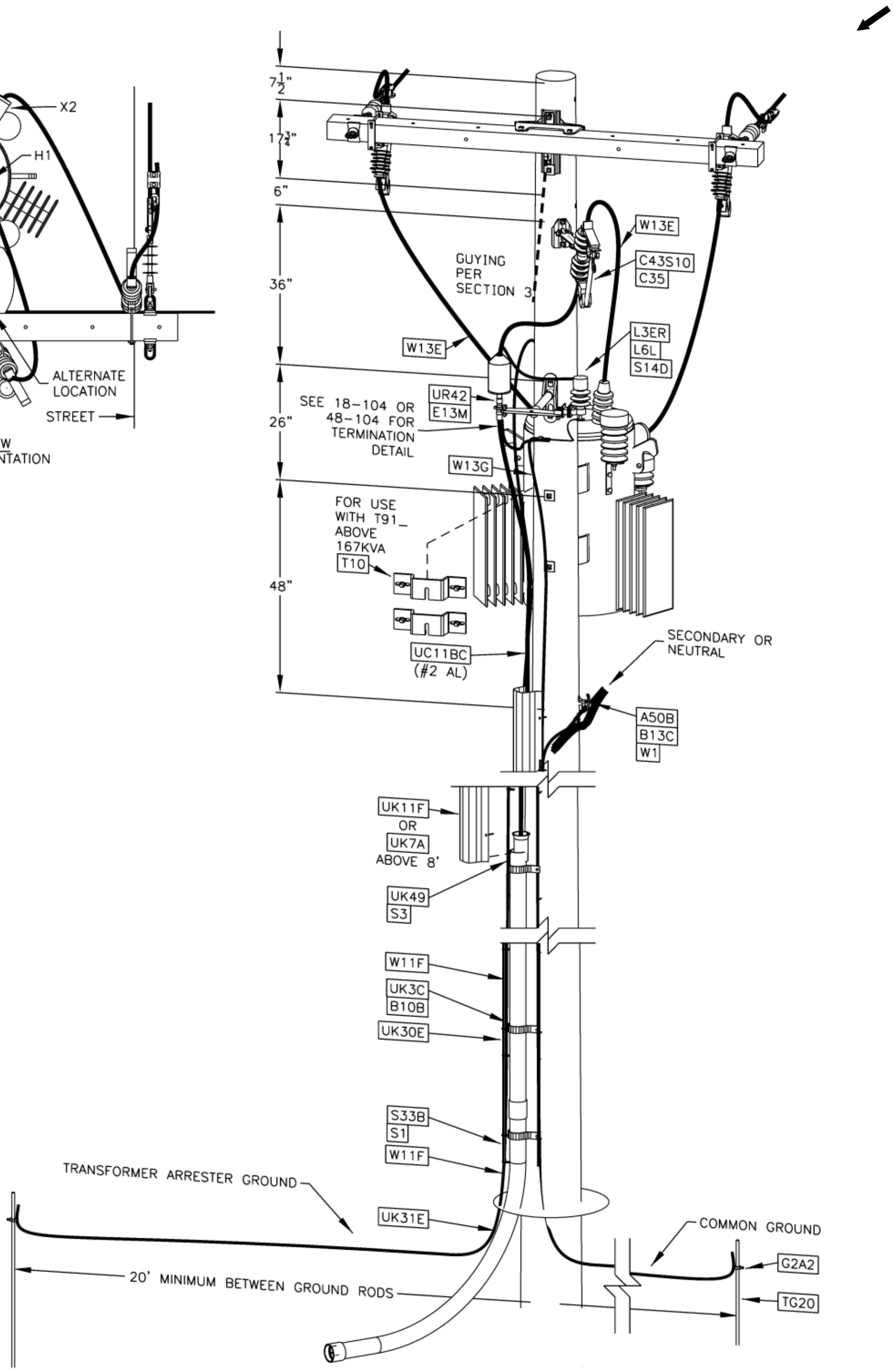
NOTES:

1. REMOVE HIGH-SIDE ARRESTERS ON TRANSFORMER (AT H1 AND IF ONE EXISTS AT H2). CONNECT H2, CONCENTRIC NEUTRAL AND RISER ARRESTER LEAD TO THE COMMON GROUND.
2. CONNECT THE LOW-SIDE ARRESTERS ON THE TRANSFORMER (AT X1 AND X2) AND THE TANK GROUND TO THE SEPARATE TRANSFORMER GROUND.
3. DO NOT CONNECT TRANSFORMER ARRESTER GROUND TO THE SECONDARY/NEUTRAL.

Designer	Drawing	Date
MPR	od18117	6/26/18

SINGLE PHASE 5kV DELTA x 15kV WYE STEP-UP RATIO TRANSFORMER WITH DOUBLE SINGLE PHASE 200A CABLE RISER			
ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/18	18-117		





NOTES:

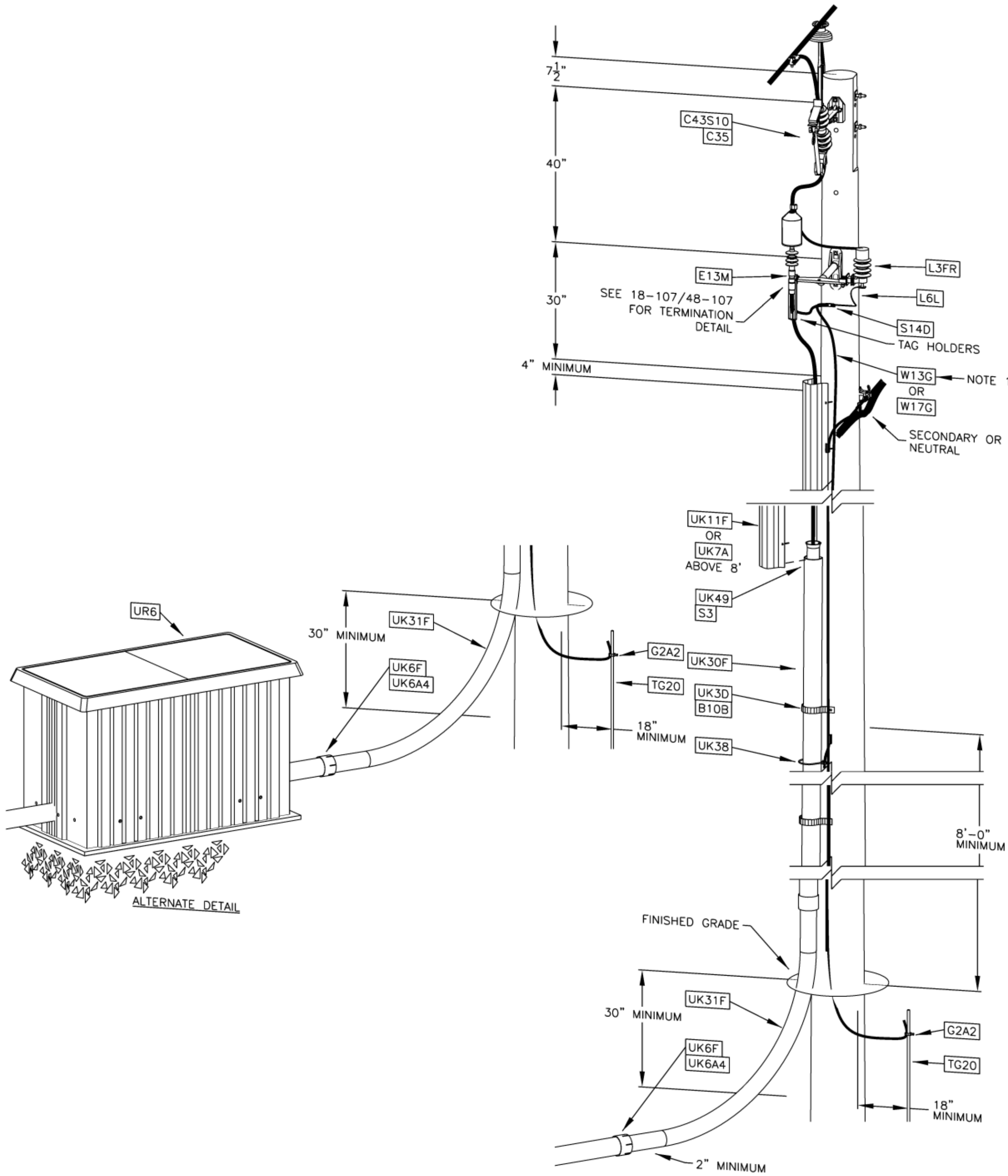
1. REMOVE HIGH-SIDE ARRESTERS ON TRANSFORMER (AT H1 AND IF ONE EXISTS AT H2). CONNECT H2, CONCENTRIC NEUTRAL AND RISER ARRESTER LEAD TO THE COMMON GROUND.
2. CONNECT THE LOW-SIDE ARRESTERS ON THE TRANSFORMER (AT X1 AND X2) AND THE TANK GROUND TO THE SEPARATE TRANSFORMER GROUND.
3. DO NOT CONNECT TRANSFORMER ARRESTER GROUND TO THE SECONDARY/NEUTRAL.
4. GUYING OF POLE TO BE DONE FOR THE DELTA CIRCUIT WITH TWO 54" FIBERGLASS RODS (STANDARD 3.4.20)

Designer	Drawing	Date
MPR	od18118	6/26/18

Supersedes 7/18 – Title update.

SINGLE PHASE STEP-UP 5 kV DELTA x 15 kV WYE TRANSFORMER INSTALLATION AND SINGLE CABLE RISER DEADEND

ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		18-118	7/19



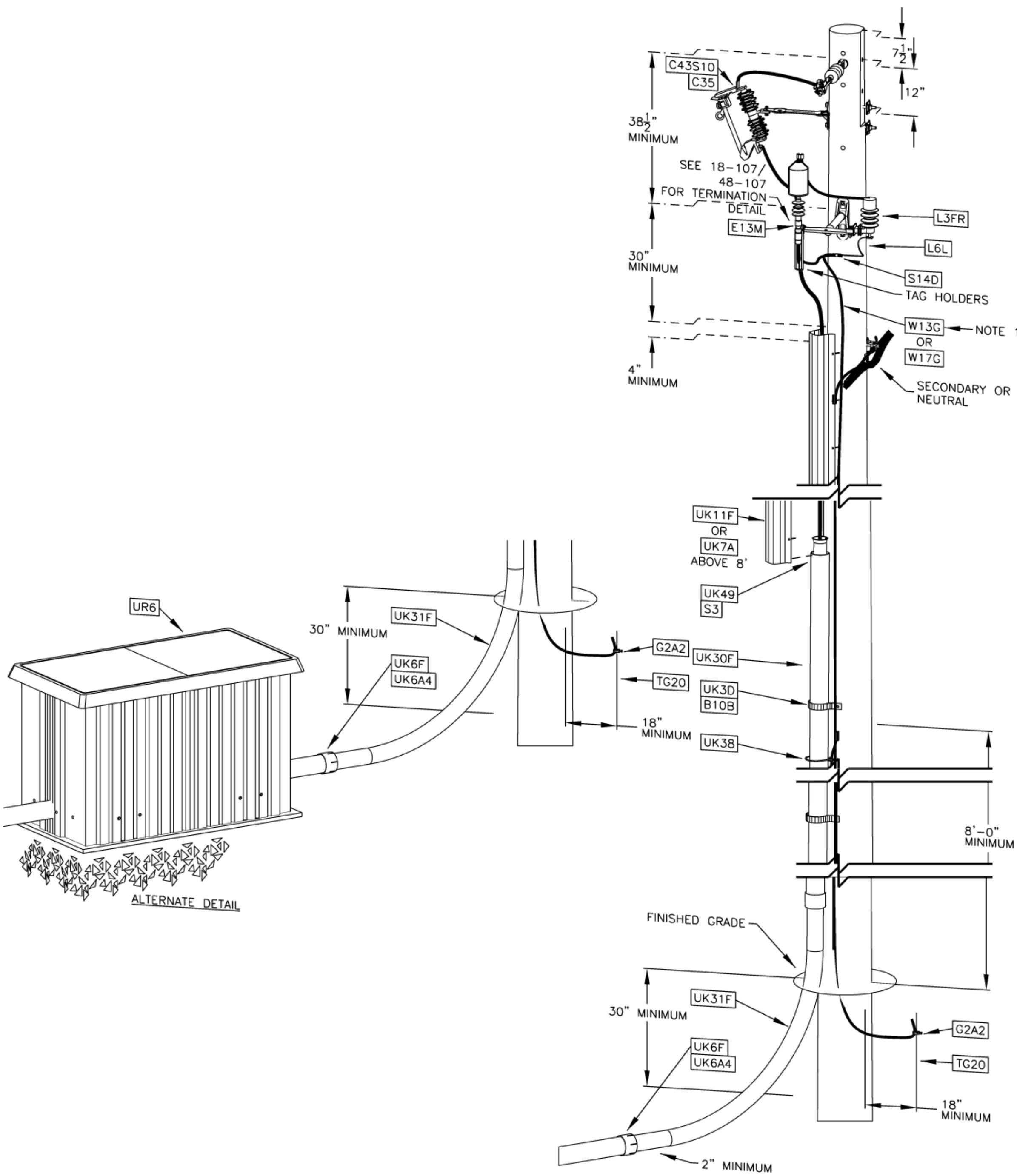
NOTES:
1. CAUTION – THIS DOWN LEAD IS PART OF THE PRIMARY NEUTRAL CONNECTION. JUMPER BEFORE REMOVING UNLESS CUTOUT IS OPEN.

Designer	Drawing	Date
MPR	od18124	6/26/18

Supersedes 7/15 -3D Drawing Conversion

SINGLE PHASE OPEN WIRE RISER WITH FUSED CUTOUT – 15kV

New Drawing



NOTES:
1. CAUTION – THIS DOWN LEAD IS PART OF THE PRIMARY NEUTRAL CONNECTION. JUMPER BEFORE REMOVING UNLESS CUTOUT IS OPEN.

Designer	Drawing	Date
MPR	od18124A	7/22/21

SINGLE PHASE RISER WITH FUSED CUTOUT DEADEND – 15kV

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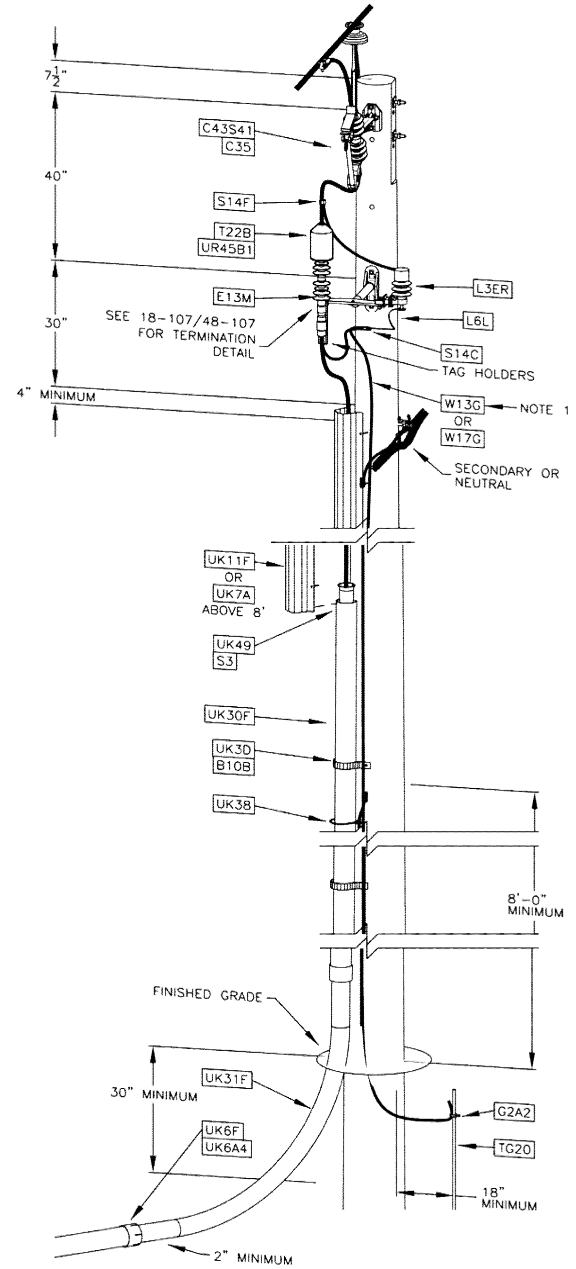
MU = @18-125CC27K(I)(X)	Single Phase Riser, 35kV, (I) Cutout Body Size, (X) Fuse Type, In Riser Guard
MU = @18-125CC27K(I)(X)C	Single Phase Riser, 35kV, (I) Cutout Body Size, (X) Fuse Type, In Conduit

Supersedes 7/18- Updated drawing, Item T22B



NOTES:

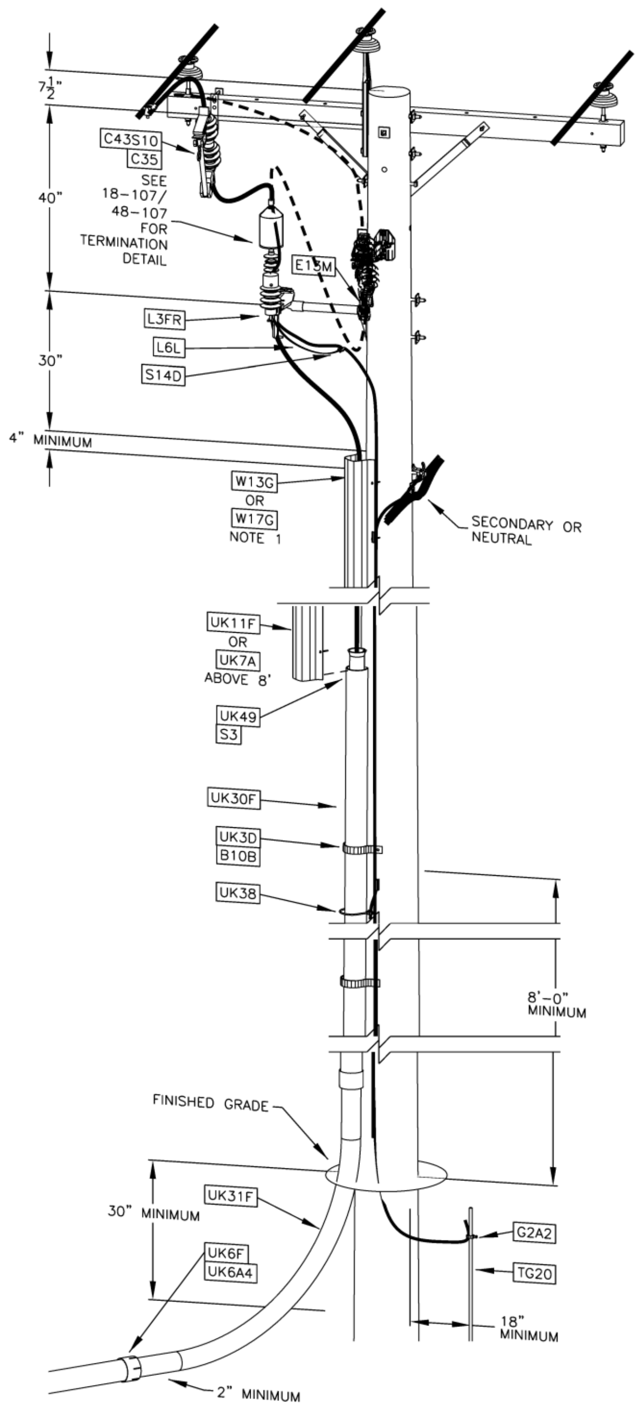
1. CAUTION – THIS DOWN LEAD IS PART OF THE PRIMARY NEUTRAL CONNECTION. JUMPER BEFORE REMOVING UNLESS CUTOUT IS OPEN.

Designer	Drawing	Date
MPR	od18124M	12/3/18

SINGLE PHASE OPEN WIRE RISER WITH FUSED CUTOUT - 35KV

MAINTENANCE ONLY

MU = @18-125CC(Y)K(I)(X)	Single Phase Riser, (Y) Insulation Rating, (I) Cutout Body Size, (X)Fuse Type, In Riser Guard
MU = @18-125CC(Y)K(I)(X)C	Single Phase Riser, (Y) Insulation Rating, (I) Cutout Body Size, (X) Fuse Type, In Conduit



Supersedes 7/13 Issue – 3D Drawing Conversion

NOTES:
1. CONTINUE CONCENTRIC NEUTRAL TO SYSTEM NEUTRAL USING A CONDUCTOR OF EQUIVALENT SIZE TO THE UNDERGROUND CABLE CONCENTRIC NEUTRAL (I.E. #2 OR 2/0).

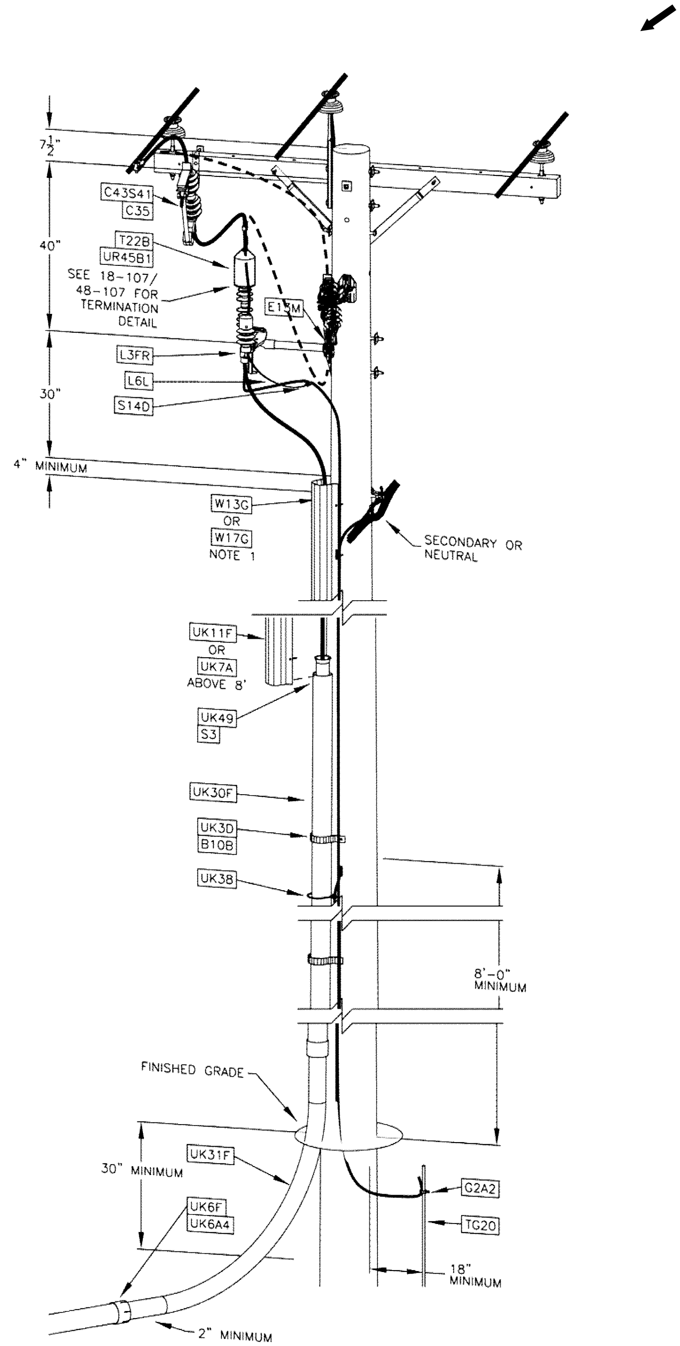
Designer	Drawing	Date
MPR	od18125	6/26/18

SINGLE PHASE RISER WITH CROSSARM MOUNTED FUSED CUTOUT - 15KV

ISSUE	PAGE NUMBER		
7/18	18-125	OVERHEAD CONSTRUCTION STANDARD	ppl

MU = @18-125CC27K(I)(X)	Single Phase Riser, 35kV, (I) Cutout Body Size, (X) Fuse Type, In Riser Guard
MU = @18-125CC27K(I)(X)C	Single Phase Riser, 35kV, (I) Cutout Body Size, (X) Fuse Type, In Conduit

Supersedes 7/18 – Updated drawing, Item T22B



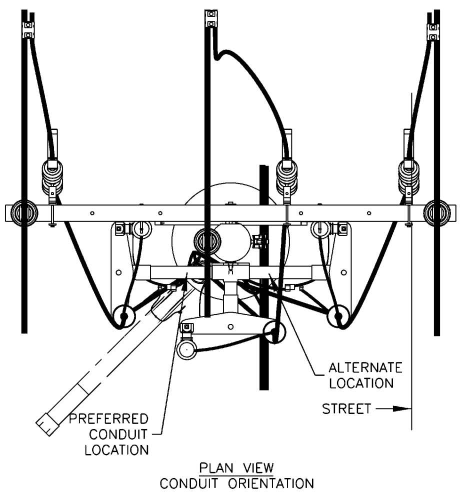
NOTES:
1. CONTINUE CONCENTRIC NEUTRAL TO SYSTEM NEUTRAL USING A CONDUCTOR OF EQUIVALENT SIZE TO THE UNDERGROUND CABLE CONCENTRIC NEUTRAL (I.E. #2 OR 2/0).

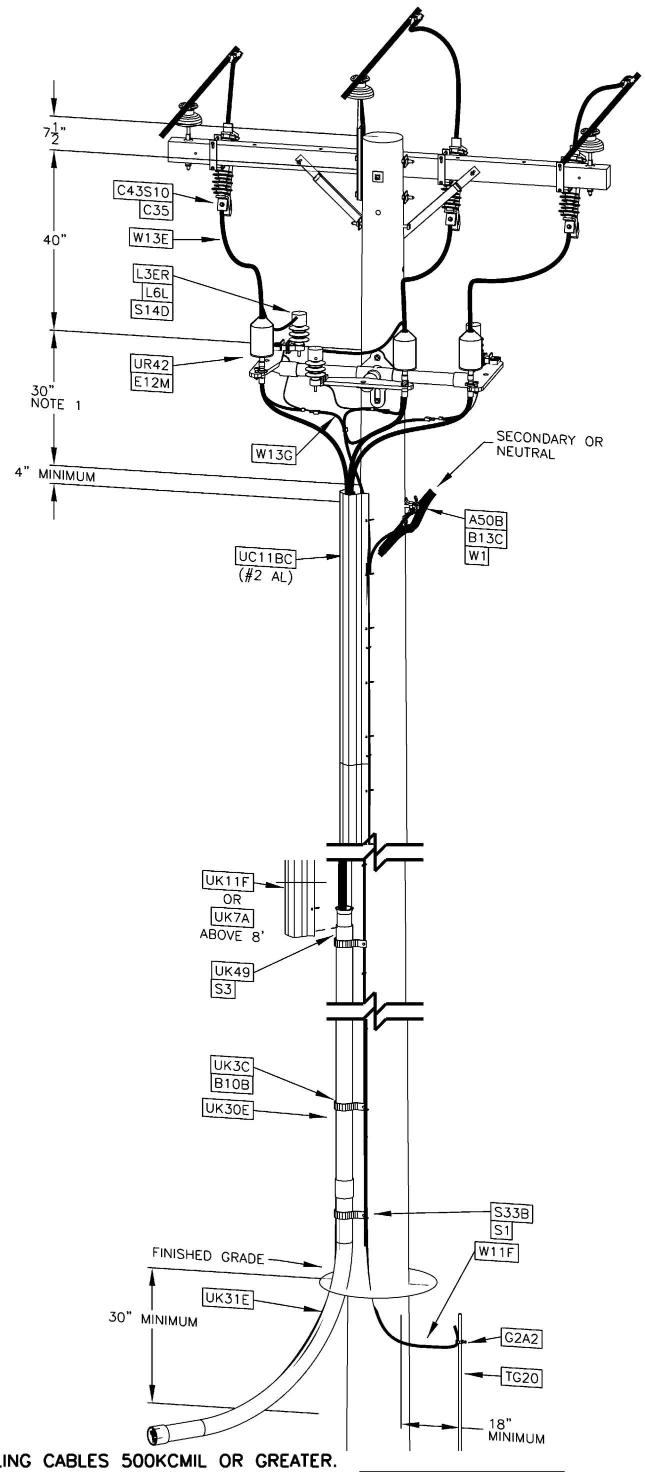
Designer	Drawing	Date
MPR	od18125M	12/3/18

SINGLE PHASE RISER WITH CROSSARM MOUNTED FUSED CUTOUT - 35KV
MAINTENANCE ONLY

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	18-125M	7/19

MU = @18-126CC(Y)K(I)(X)	3 Ph Riser, (Y) Insulation Rating, (I) Cutout Body Size, (X) Fuse Type, In Riser Guard
MU = @18-126CC(Y)K(I)(X)C	3 Ph Riser, (Y) Insulation Rating, (I) Cutout Body Size, (X) Fuse Type, In Conduit





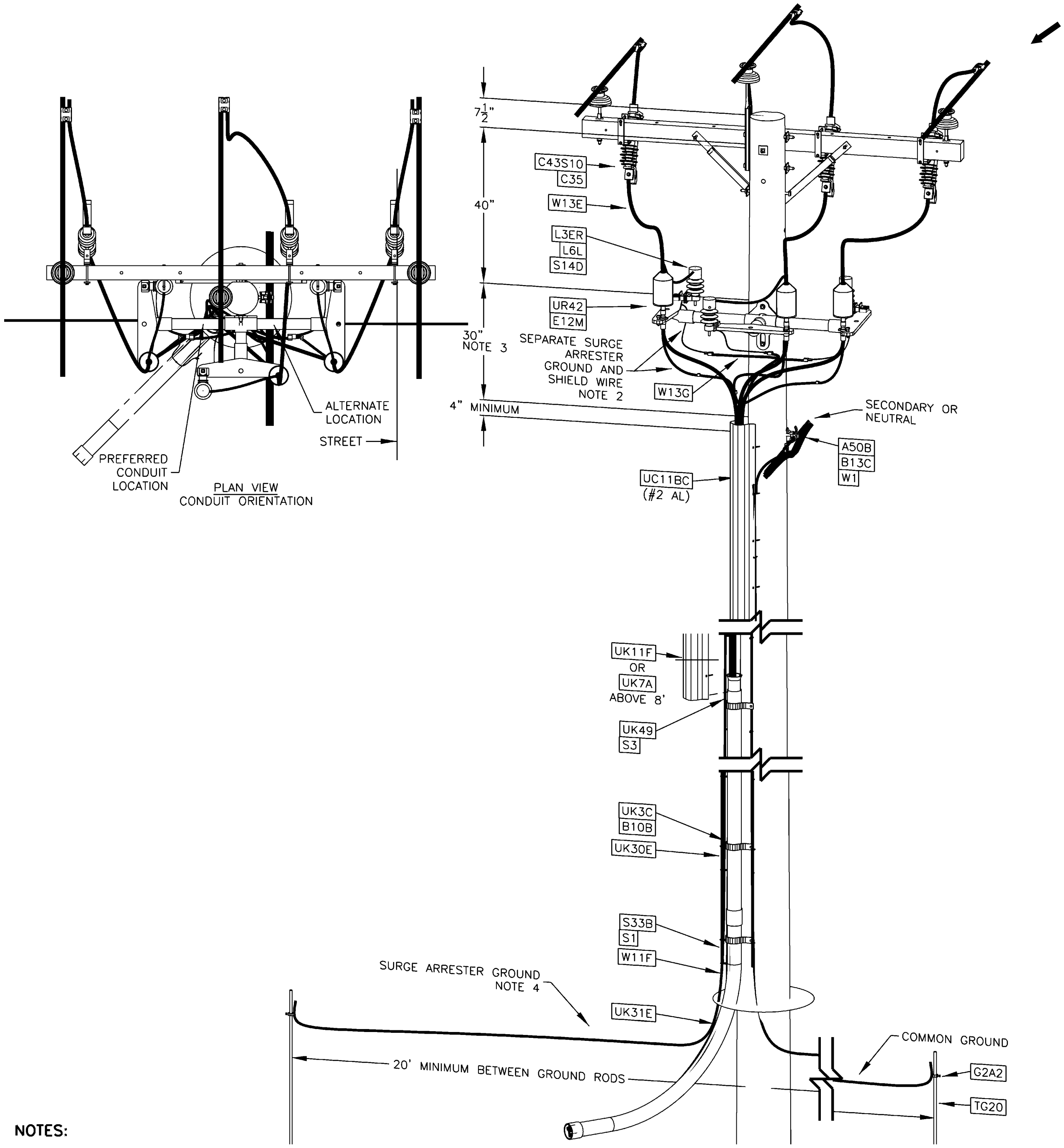
Supersedes 7/19 Issue – Note 2 added

NOTES:

1. INCREASE POLE SPACING TO 50" WHEN INSTALLING CABLES 500KCMIL OR GREATER.
2. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od18126	6/30/20

MU = @18-126CC(Y)K(I)(X)	3 Ph Riser, (Y) Insulation Rating, (I) Cutout Body Size, (X) Fuse Type, In Riser Guard
MU = @18-126CC(Y)K(I)(X)C	3 Ph Riser, (Y) Insulation Rating, (I) Cutout Body Size, (X) Fuse Type, In Conduit



NOTES:
1. SEE SECTION 3 FOR GUY ASSEMBLY INSTALLATION DETAILS
2. ON DELTA PRIMARY CIRCUITS THE SURGE ARRESTER GROUNDING CONDUCTOR AND THE SECONDARY NEUTRAL GROUNDING CONDUCTOR SHALL BE RUN SEPARATELY TO TWO GROUND RODS. SEE STANDARD 13-111 FOR GROUNDING DETAILS.
3. INCREASE POLE SPACING TO 50" WHEN INSTALLING CABLE 500KCMIL OR GREATER.
4. DESIGNER TO MANUALLY ADD ADDITIONAL GROUND CU TO 18-126 MU'S FOR DELTA APPLICATIONS.
5. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od18126D	6/30/20

Supersedes 7/19 – Note 5 added

Business Use

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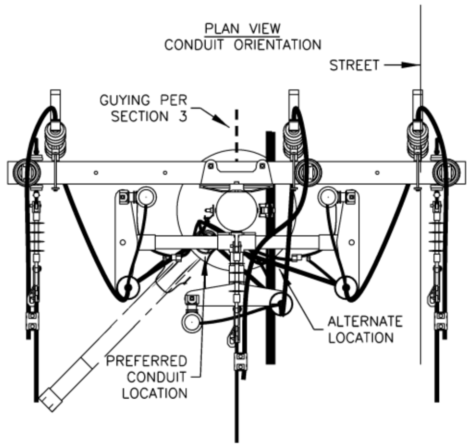
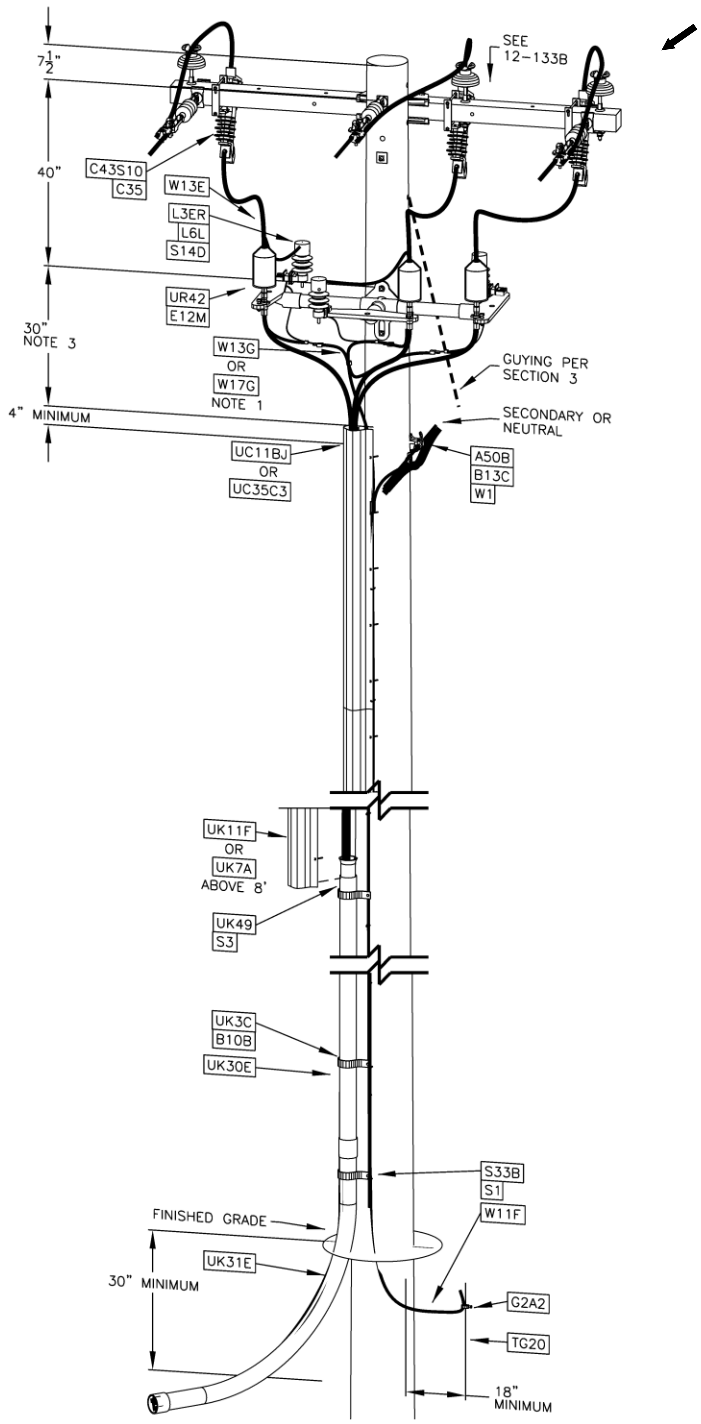
SEE PAGE 18-126 FOR MACROS

Supersedes 7/20 Issue – Replaced pole top construction to match 12-133B





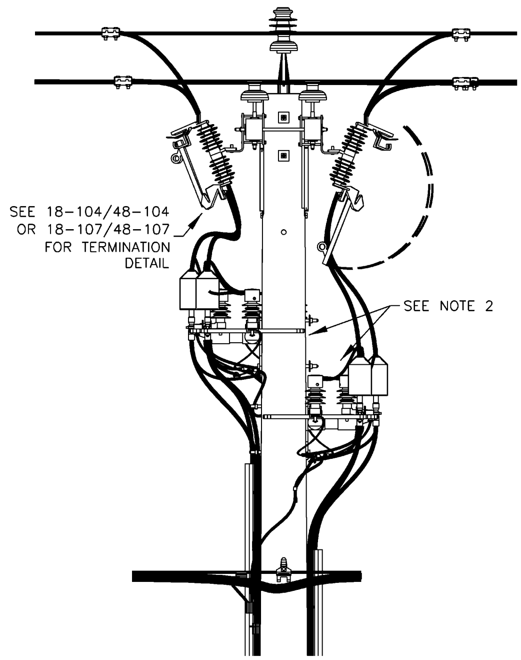
NOTES:

1. CONTINUE CONCENTRIC NEUTRAL TO SYSTEM NEUTRAL USING A CONDUCTOR OF EQUIVALENT SIZE TO THE UNDERGROUND CABLE CONCENTRIC NEUTRAL (I.E. #2 OR 2/0).
2. SURGE ARRESTERS PROTECTING THE OVERHEAD LINE SHALL BE INSTALLED WITHIN 300' FROM THE DISCONNECT DEVICE.
3. INCREASE POLE SPACING TO 50" WHEN INSTALLING CABLES 500KCMIL OR GREATER.
4. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

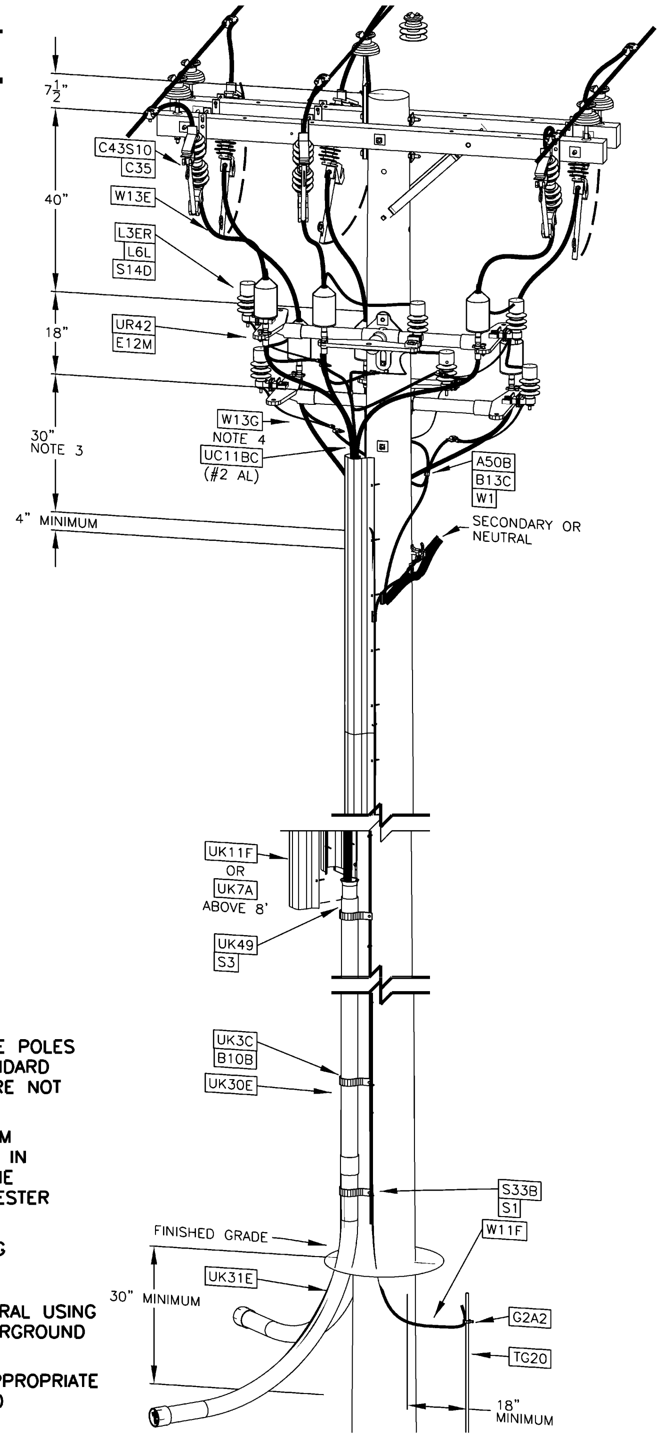
Designer	Drawing	Date
MPR	od18127	11/30/20

15-35KV THREE PHASE RISER DEADEND POLE WITH FUSED CUTOUTS 200A MAXIMUM

MU = @18-126CC(Y)K(I)(X)	3Phase Riser, (Y) Insulation Rating, (I) Cutout Body Size, (X) Fuse Type, In Riser Guard
MU = @18-126CC(Y)K(I)(X)C	3Phase Riser, (Y) Insulation Rating, (I) Cutout Body Size, (X) Fuse Type, In Conduit



SIDE VIEW



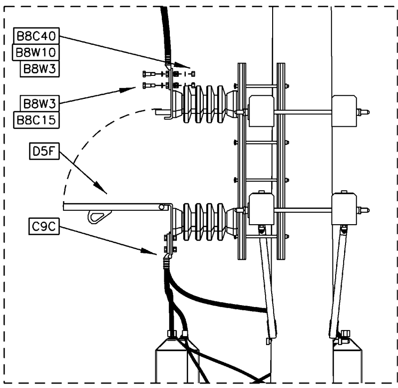
Designer	Drawing	Date
MPR	od18128	6/30/20

NOTES:

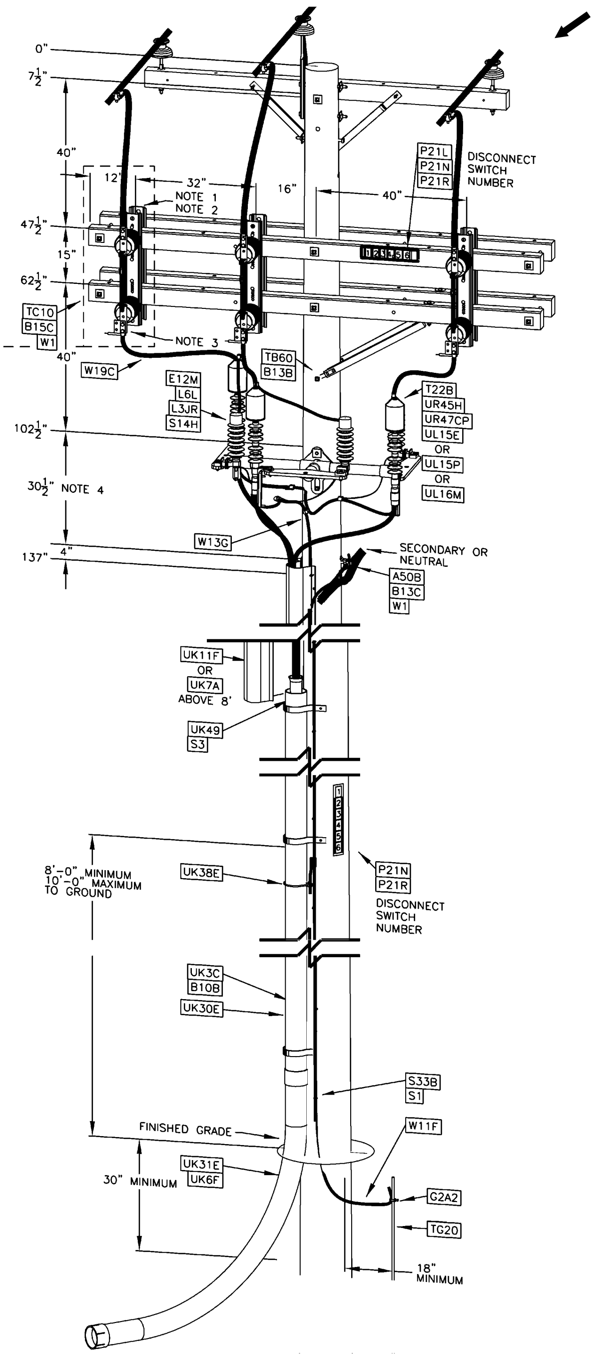
1. IMPORTANT: INSTALLATION OF RISERS ON SEPARATE POLES IS THE PREFERRED CONSTRUCTION AND THIS STANDARD SHOULD ONLY BE USED WHEN OTHER OPTIONS ARE NOT PRACTICAL.
2. USE MIDDLE POSITION OF THE RISER BRACKET ARM WHEN INSTALLING ARRESTERS ON BOTH BRACKETS IN ORDER TO HAVE ENOUGH CLEARANCE BETWEEN THE UPPER ARRESTER GROUND LEAD AND LOWER ARRESTER PRIMARY TAP.
3. INCREASE POLE SPACING TO 50" WHEN INSTALLING CABLES 500KCMIL OR GREATER.
4. CONTINUE CONCENTRIC NEUTRAL TO SYSTEM NEUTRAL USING A CONDUCTOR OF EQUIVALENT SIZE TO THE UNDERGROUND CABLE CONCENTRIC NEUTRAL (I.E. #2 OR 2/0).
5. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Supersedes 7/19 Issue – Note 5 added

MU = @18-335(W) Add C If In Conduit	3 Ph Riser, 600A, (W) = A, B, C Cable Size with A = 500, B = 750, C = 1000, 15kV
MU = @18-335(W)35KV Add C If In Conduit	3 Ph Riser, 600A, (W) = A, B, C Cable Size with A = 500, B = 750, C = 1000, 35kV



SWITCH DETAIL

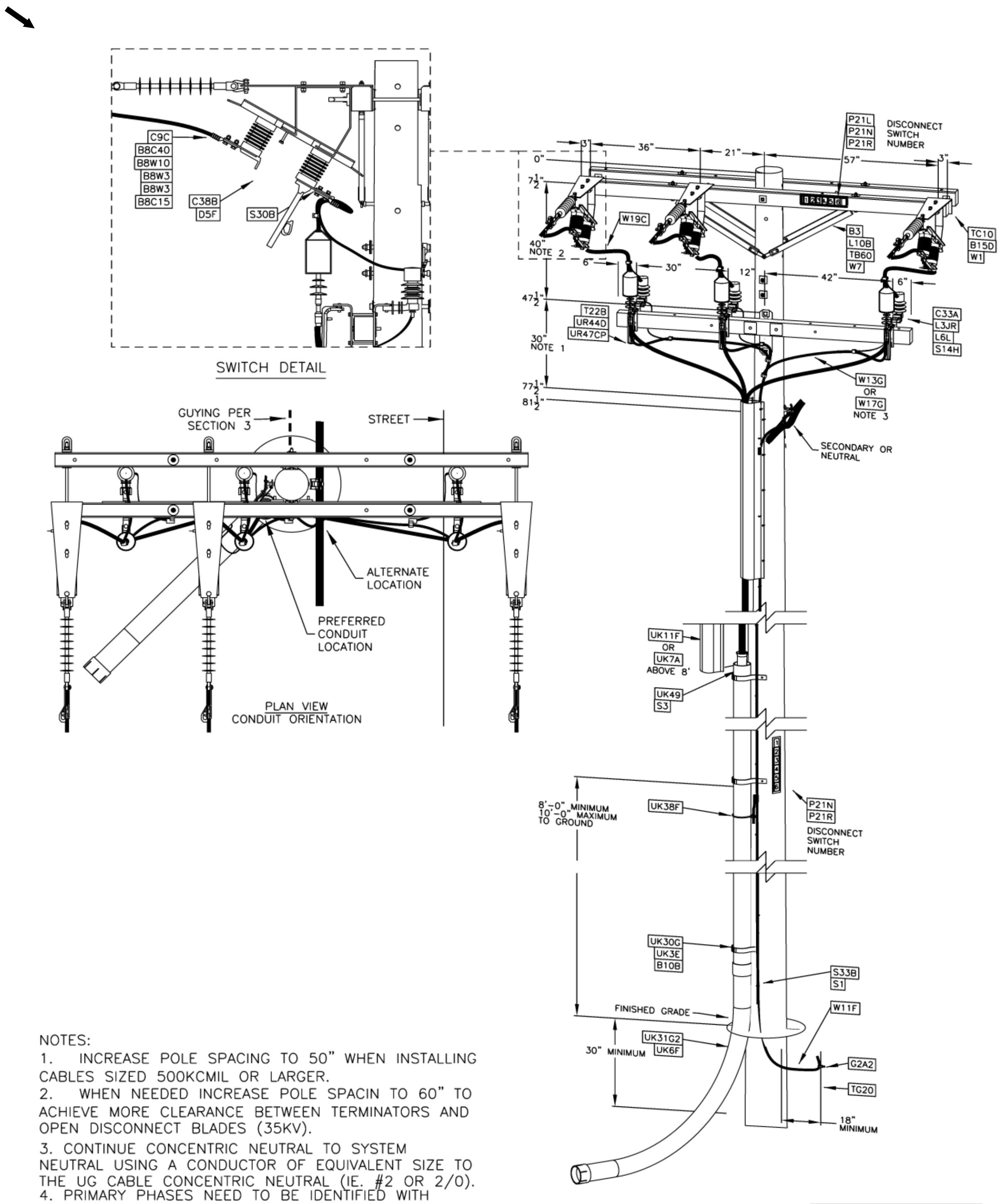


NOTES:
1. SURGE ARRESTERS CONNECTED TO UNGROUNDED PRIMARY CIRCUITS MUST BE SEPARATELY GROUNDED AND NOT INTERCONNECTED TO THE SYSTEM NEUTRAL AND GROUND.
2. IF CONSTRUCTED IN A LOCATION THAT IS NOT BUCKET ACCESSIBLE, SWITCHES MAY BE PLACED ON THE BACK SIDE OF THE POLE TO MAKE THE POLE EASIER TO CLIMB.
3. IF USING A FLAG STYLE TERMINAL CONNECTION, THE REQUIRED TORQUE IS 40FT-LBS.
4. INCREASE POLE SPACING TO 50" WHEN INSTALLING CABLES SIZED 500KCMIL OR LARGER.
5. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Supersedes 7/19 Issue – Switch numbering on crossarm and note 5 added

Designer	Drawing	Date
MPR	od18335	6/30/20

MU = @18-336(W) Add C If In Conduit	3 Ph Riser, 600A, (W) = A, B, C Cable Size with A = 500, B = 750, C = 1000, 15kV
MU = @18-336(W)35KV Add C If In Conduit	3 Ph Riser, 600A, (W) = A, B, C Cable Size with A = 500, B = 750, C = 1000, 35kV



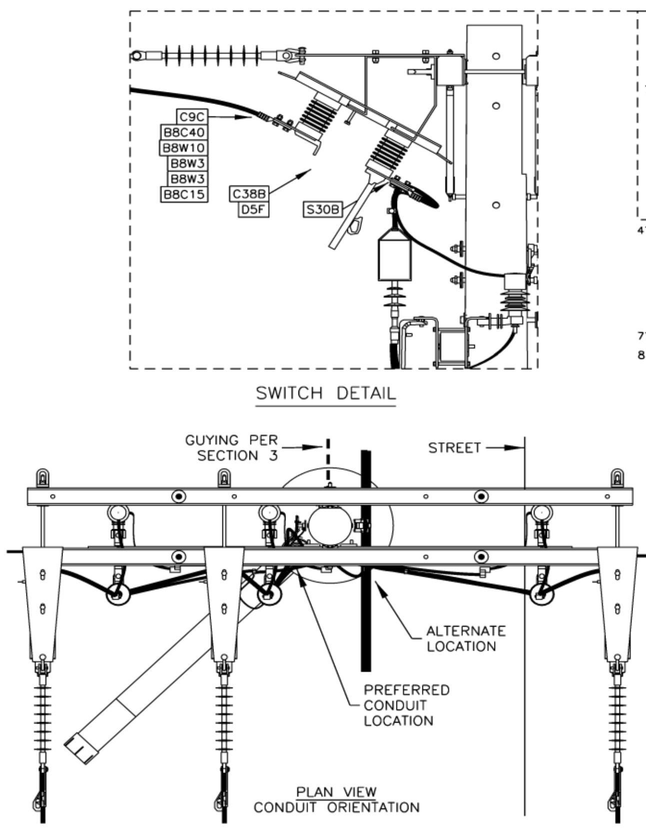
Supersedes 7/20 Issue- Added label for C33A

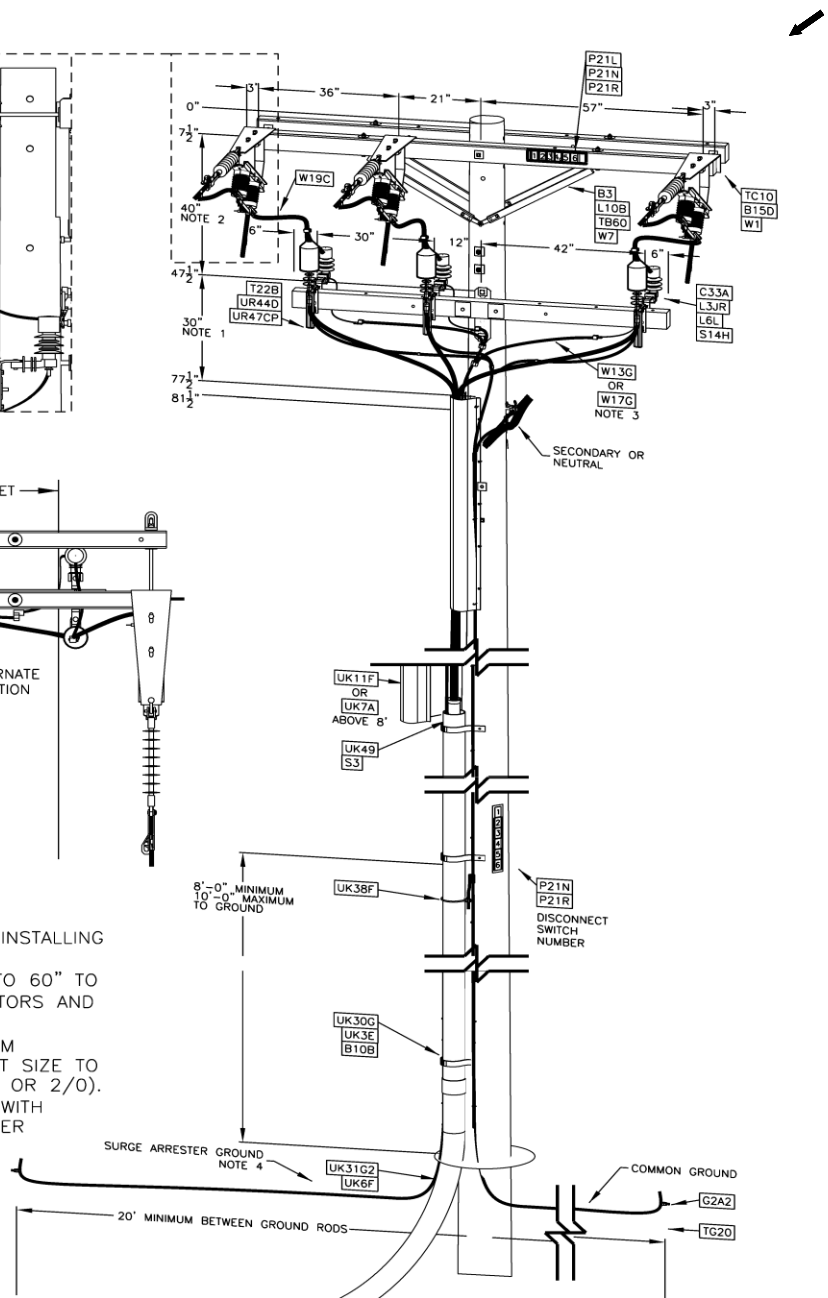
NOTES:
1. INCREASE POLE SPACING TO 50" WHEN INSTALLING CABLES SIZED 500KCMIL OR LARGER.
2. WHEN NEEDED INCREASE POLE SPACIN TO 60" TO ACHIEVE MORE CLEARANCE BETWEEN TERMINATORS AND OPEN DISCONNECT BLADES (35KV).
3. CONTINUE CONCENTRIC NEUTRAL TO SYSTEM NEUTRAL USING A CONDUCTOR OF EQUIVALENT SIZE TO THE UG CABLE CONCENTRIC NEUTRAL (IE. #2 OR 2/0).
4. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od18336	1/15/21

MU = @18-336(W) Add C If In Conduit	3 Ph Riser, 600A, (W) = A, B, C Cable Size with A = 500, B = 750, C = 1000, 15kV
MU = @18-336(W)35KV Add C If In Conduit	3 Ph Riser, 600A, (W) = A, B, C Cable Size with A = 500, B = 750, C = 1000, 35kV

Supersedes 7/20 Issue- Added label for C33A

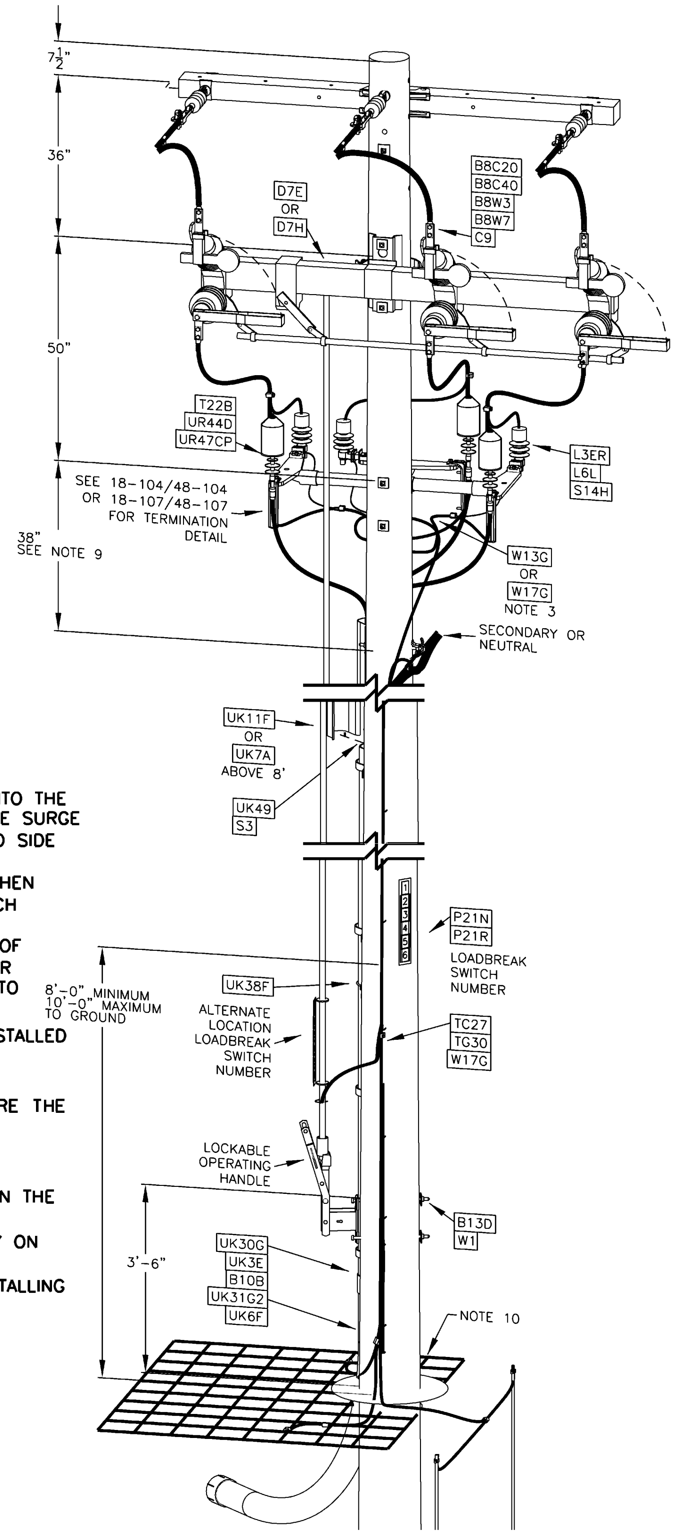




NOTES:
1. INCREASE POLE SPACING TO 50" WHEN INSTALLING CABLES SIZED 500KCMIL OR LARGER.
2. WHEN NEEDED INCREASE POLE SPACIN TO 60" TO ACHIEVE MORE CLEARANCE BETWEEN TERMINATORS AND OPEN DISCONNECT BLADES (35KV).
3. CONTINUE CONCENTRIC NEUTRAL TO SYSTEM NEUTRAL USING A CONDUCTOR OF EQUIVALENT SIZE TO THE UG CABLE CONCENTRIC NEUTRAL (IE. #2 OR 2/0).
4. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od183360	1/15/21

MU = @18-337 LBSW(Y)(W)	3Ph Riser 600A Loadbreak, (Y) = Voltage (W) = A, B, C Cable Size with A = 500, B = 750, C = 1000
MU = @18-337 LBSW(Y)(W)C	3Ph Riser 600A Loadbreak, (Y) = Voltage (W) = A, B, C Cable Size with A = 500, B = 750, C = 1000, In Conduit



NOTES:

1. SURGE ARRESTERS SHALL BE INSTALLED ONTO THE SOURCE SIDE POLE WITHIN 300'. THE RISER TYPE SURGE ARRESTERS SHALL BE INSTALLED ONTO THE LOAD SIDE PROTECTING BOTH SWITCH AND TERMINATORS.
2. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
3. ON COVERED TAP CONDUCTORS, PROVIDE 6" OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES. USE 5/8" THRU BOLTS TO MOUNT OPERATING ROD GUIDES.
4. PRIMARY CONDUCTORS SHALL NEVER BE INSTALLED TO ONLY ONE SIDE OF THE SWITCH AS MAXIMUM DEADEND LOADING WILL BE EXCEEDED.
5. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20 .
6. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
7. OPERATING MECHANISM SHALL BE LOCKED IN THE OPEN OR CLOSED POSITION.
8. SWITCH IDENTIFICATION MOUNTED VERTICALLY ON ROAD SIDE PROVIDING MAXIMUM VISIBILITY.
9. INCREASE POLE SPACING TO 50" WHEN INSTALLING CABLES SIZED 500KCMIL OR LARGER.
10. SEE 13-114 FOR GROUNDING DETAILS (USE W17G IN LIEU OF W11F).
11. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od18337	6/30/20

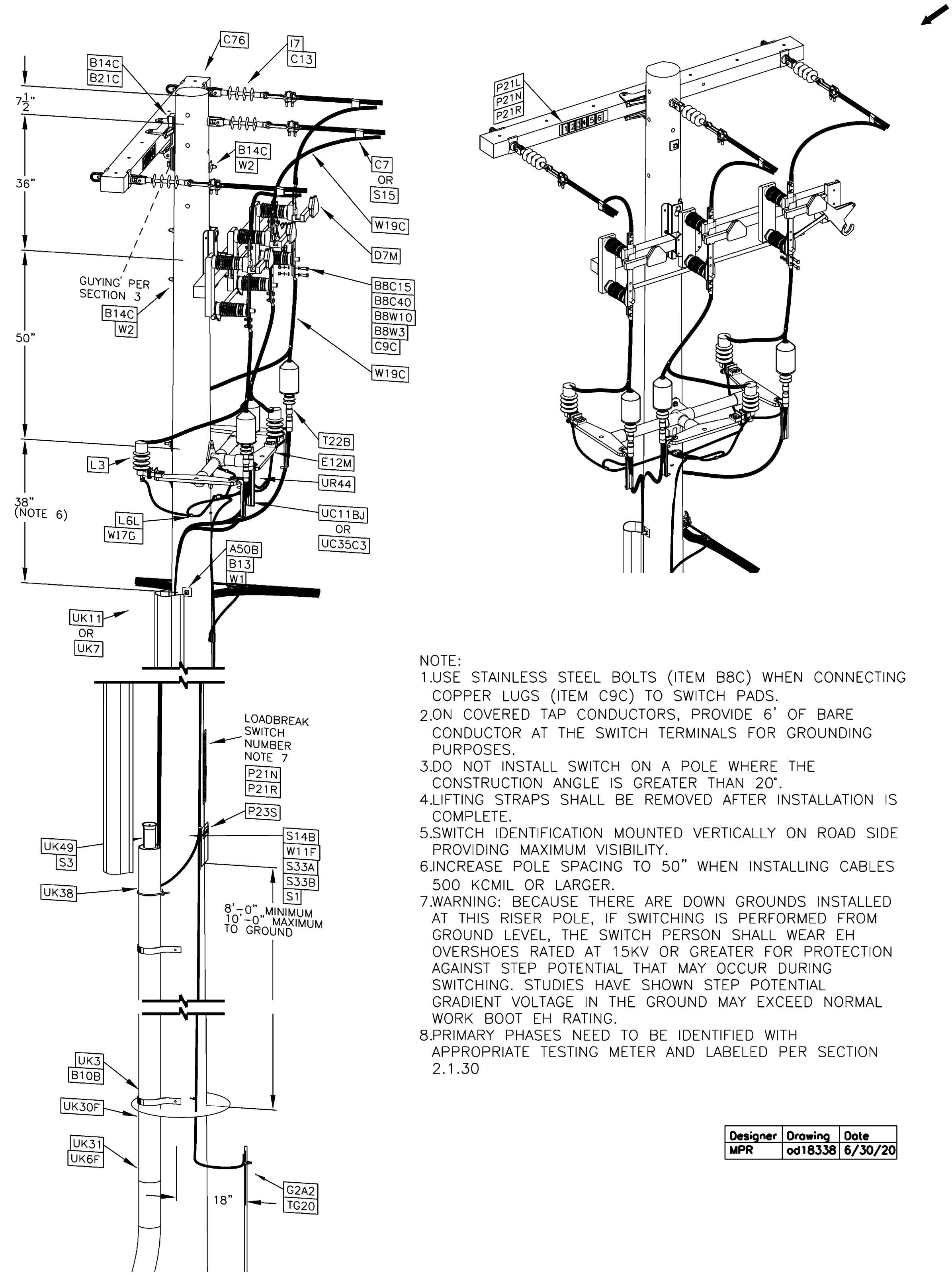
Supersedes 7/19 Issue- Removed switch numbering from crossarm and added note 11

THREE PHASE PRIMARY SECTIONALIZING - LOADBREAK SWITCH RISER POLE 15-35KV

ISSUE	PAGE NUMBER		
7/20	18-337	OVERHEAD CONSTRUCTION STANDARD	ppl

MU = @18-338LBHSSW15KV(W) add C if in Conduit	3Ph Riser 600A LDBRK, 15KV, (W) = A,B,C Cable Size with A=500,B=750,C=1000

Supersedes 7/19 Issue- Previous note 8 removed and new note 8 added



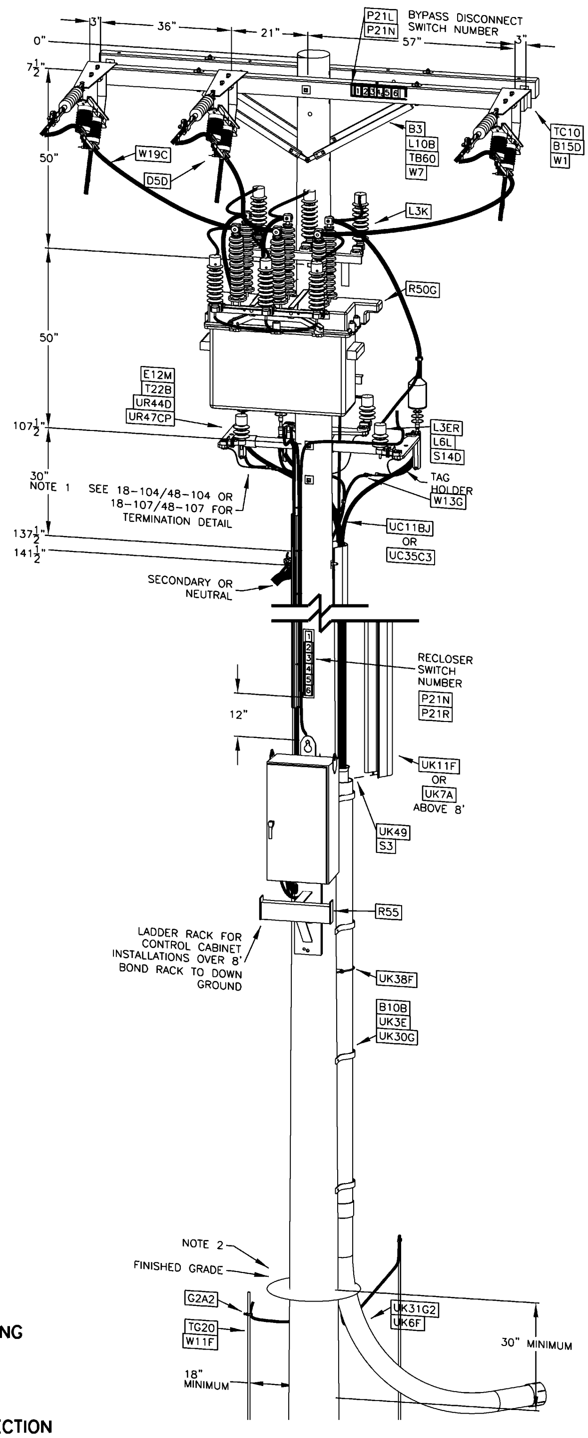
NOTE:

1. USE STAINLESS STEEL BOLTS (ITEM B8C) WHEN CONNECTING COPPER LUGS (ITEM C9C) TO SWITCH PADS.
2. ON COVERED TAP CONDUCTORS, PROVIDE 6' OF BARE CONDUCTOR AT THE SWITCH TERMINALS FOR GROUNDING PURPOSES.
3. DO NOT INSTALL SWITCH ON A POLE WHERE THE CONSTRUCTION ANGLE IS GREATER THAN 20°.
4. LIFTING STRAPS SHALL BE REMOVED AFTER INSTALLATION IS COMPLETE.
5. SWITCH IDENTIFICATION MOUNTED VERTICALLY ON ROAD SIDE PROVIDING MAXIMUM VISIBILITY.
6. INCREASE POLE SPACING TO 50" WHEN INSTALLING CABLES 500 KCMIL OR LARGER.
7. WARNING: BECAUSE THERE ARE DOWN GROUNDS INSTALLED AT THIS RISER POLE, IF SWITCHING IS PERFORMED FROM GROUND LEVEL, THE SWITCH PERSON SHALL WEAR EH OVERSHOES RATED AT 15KV OR GREATER FOR PROTECTION AGAINST STEP POTENTIAL THAT MAY OCCUR DURING SWITCHING. STUDIES HAVE SHOWN STEP POTENTIAL GRADIENT VOLTAGE IN THE GROUND MAY EXCEED NORMAL WORK BOOT EH RATING.
8. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

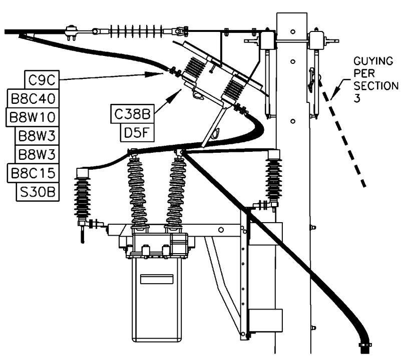
Designer	Drawing	Date
MPR	od18338	6/30/20

THREE PHASE RISE WITH HOOKSTICK SWITCH – 15kV

RISER MU = @18-336(X) Add C if in Conduit	3Ph Riser 600A Loadbreak, (X) = A, B, C Cable Size with A = 500, B = 750, C = 1000 15 kV
RISER MU = @18-336(X)35kV Add C if in Conduit	3Ph Riser 600A Loadbreak, (Y) = A, B, C Cable Size with A = 500, B = 750, C = 1000, 35 kV
RECLOSER MU	See Page 12-333 For Recloser MU’s



Designer	Drawing	Date
MPR	od18340	6/30/20



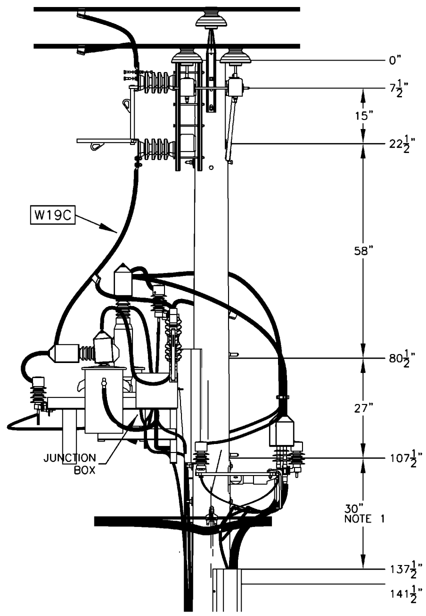
SIDE VIEW

NOTES:
1. INCREASE POLE SPACING TO 50" WHEN INSTALLING CABLES SIZED 500KCMIL OR LARGER.
2. SEE 13-113 FOR GROUNDING DETAILS
3. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

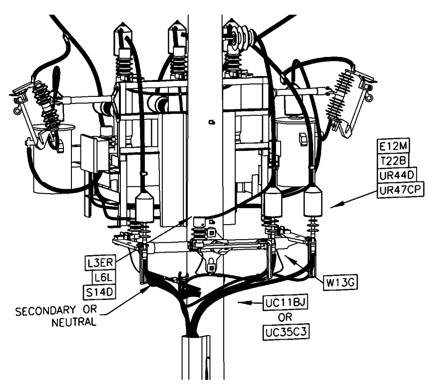
Supersedes 7/19 Issue – Switch numbering on crossarm and notes 2 and 3 added

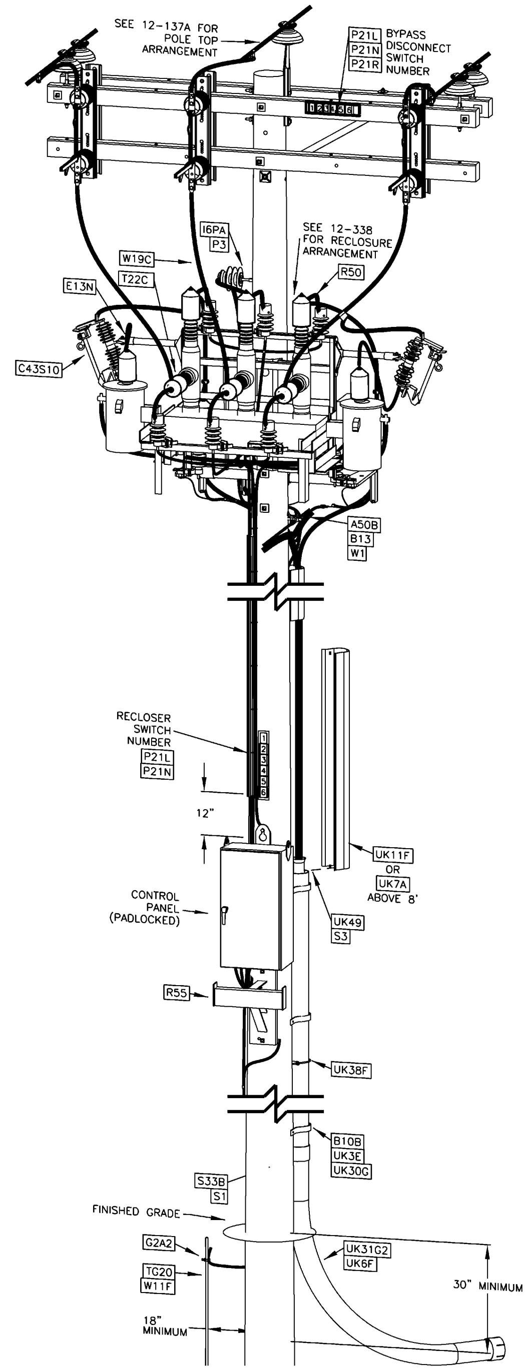
RISER MU = @18-341(W)(Y)(Z) Add C if in Conduit	3Ph Riser 600A Loadbreak, (W) = A, B, C Cable Size with A = 500, B = 750, C = 1000, 15 kV
RECLOSER MU	See Page 12-335 For Recloser MU's

Supersedes 7/19 Issue – Switch numbering on crossarm and note 2 added



SIDE VIEW



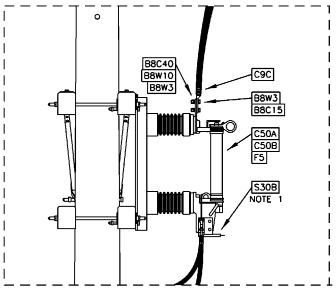


NOTES:
1. INCREASE POLE SPACING TO 50" WHEN INSTALLING CABLES SIZED 500KCMIL OR LARGER.
2. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

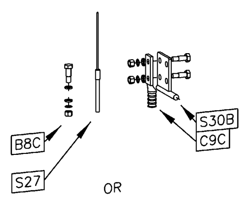
Designer	Drawing	Date
MPR	od18341	6/30/20

THREE PHASE RISER WITH RECLOSER AND DISCONNECT SWITCHES ON OPEN WIRE (0 TO 10 DEGREES)

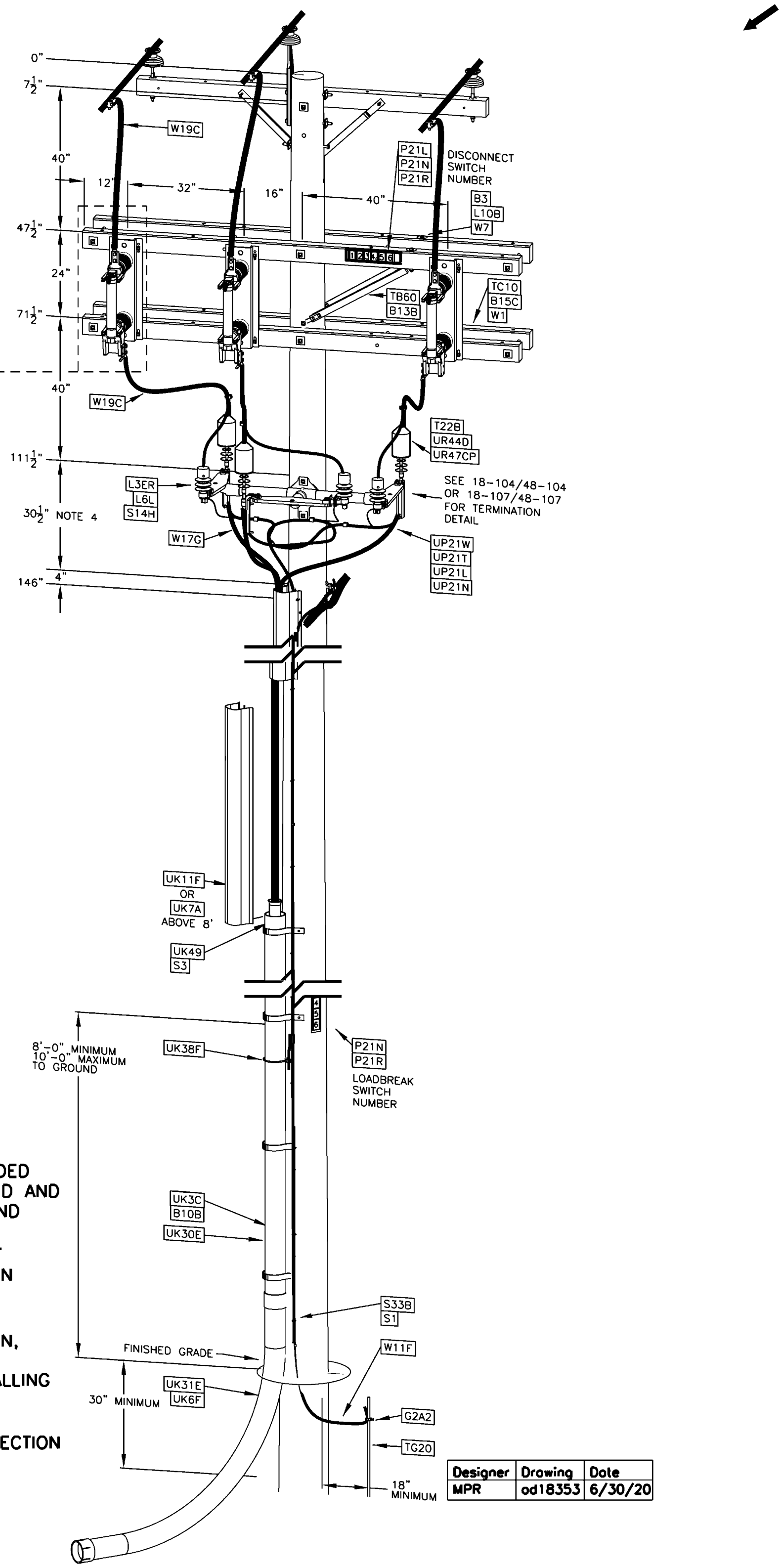
MU = @18-353(W)C50B(X)	3 Ph Riser, 600A (W) = A, B, C Cable Size with A = 500, B = 750, C = 1000 (X) = Fuse Link, 15kV
MU = @18-353(W)C50B(X)C	3 Ph Riser, 600A (W) = A, B, C Cable Size with A = 500, B = 750, C = 1000 (X) = Fuse Link, 15Kv, In Conduit



FUSE DETAIL



CONNECTION AND STUD OPTIONS



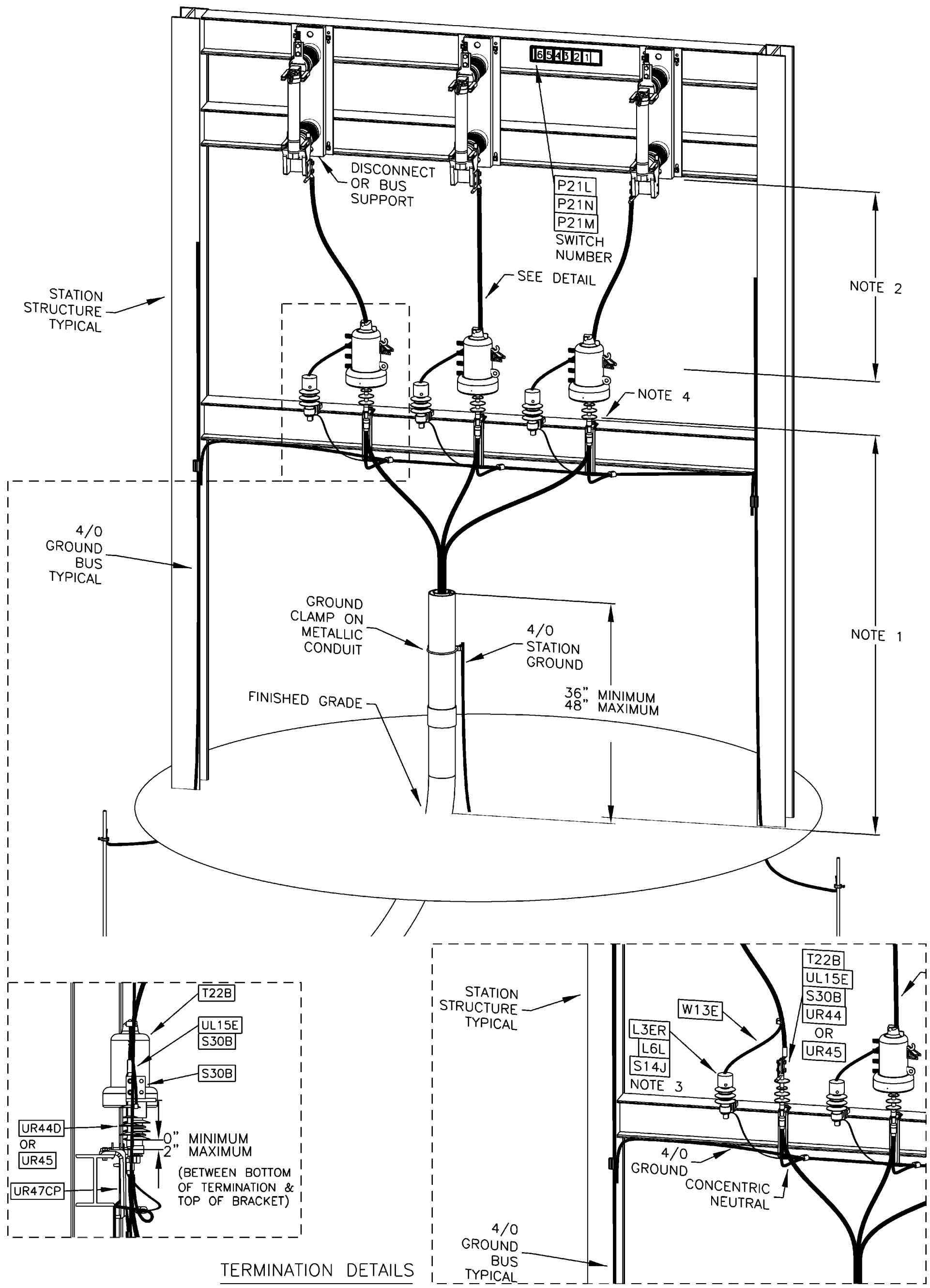
NOTES:
1. SURGE ARRESTERS CONNECTED TO UNGROUNDED PRIMARY CIRCUITS MUST BE SEPARATELY GROUNDED AND NOT INTERCONNECTED TO THE SYSTEM NEUTRAL AND GROUND.
2. IF CONSTRUCTED IN A LOCATION THAT IS NOT BUCKET ACCESSIBLE, SWITCHES MAY BE PLACED ON THE BACK SIDE OF THE POLE TO MAKE THE POLE EASIER TO CLIMB.
3. IF USING A FLAG STYLE TERMINAL CONNECTION, THE REQUIRED TORQUE IS 40FT-LBS.
4. INCREASE POLE SPACING TO 50" WHEN INSTALLING CABLES SIZED 500KCMIL OR LARGER.
5. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od18353	6/30/20

Supersedes 7/19 Issue – Switch numbering on crossarm and note 5 added

THREE PHASE PRIMARY 600A RISER WITH 40,000A POWER FUSES

Supersedes 7/18 Issue – Switch numbering on crossarm and note 5 added



TERMINATION DETAILS

NOTES:

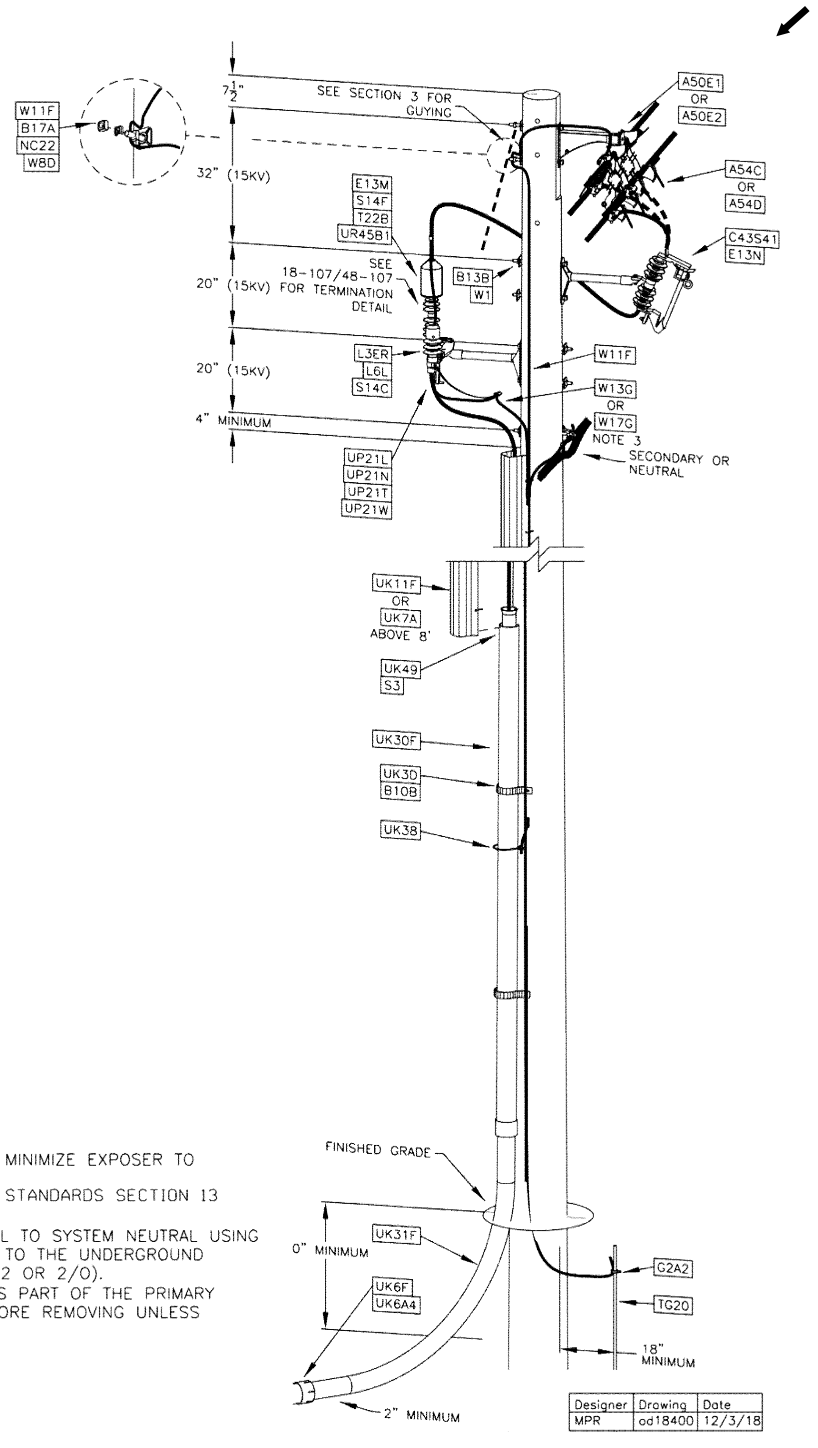
1. DISTANCE TO LIVE PARTS PER ST.02.00.002 – ELECTRICAL STATION CLEARANCES.
2. MAXIMUM DISTANCE TO BUS SUPPORT IS 5'. ALLOW SUFFICIENT DISTANCE BETWEEN THE DISCONNECTING DEVICE AND THE CABLE TERMINATION FOR MAINTENANCE AND CABLE TESTING WITHOUT VIOLATING MINIMUM APPROACH DISTANCE. ADD 3'–6" TO THE MINIMUM APPROACH DISTANCE VALUES IN THE EMPLOYEE SAFETY HANDBOOK.
3. RUN 4/0 HORIZONTAL GROUND IN WEB IF AN "I" BEAM, OR UNDERNEATH OTHER SUPPORTING STRUCTURE. CONNECT ARRESTER GROUND LEAD AND CONCENTRIC NEUTRAL TO GROUND BUS WITH SINGLE C CRIMP CONNECTOR, STANDARD ITEM S14J. KEEP LEADS AS SHORT AS POSSIBLE.
4. IF THE DISTANCE FROM GRADE TO THE TERMINATION SUPPORT IS GREATER THAN 10', INSTALL ADDITIONAL STRUCTURAL MEMBERS BELOW AND HOLD CABLE WITH CABLE POSITIONER STANDARD ITEM UR47CP. THE DISTANCE BETWEEN CABLE POSITIONERS SHALL NOT EXCEED 7'.
5. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od18370	6/30/20

SUBSTATION RISER - THREE PHASE

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	18-370	7/20

SEE PAGE 18-125 FOR MUS



Designer	Drawing	Date
MPR	od18400	12/3/18

NOTES:

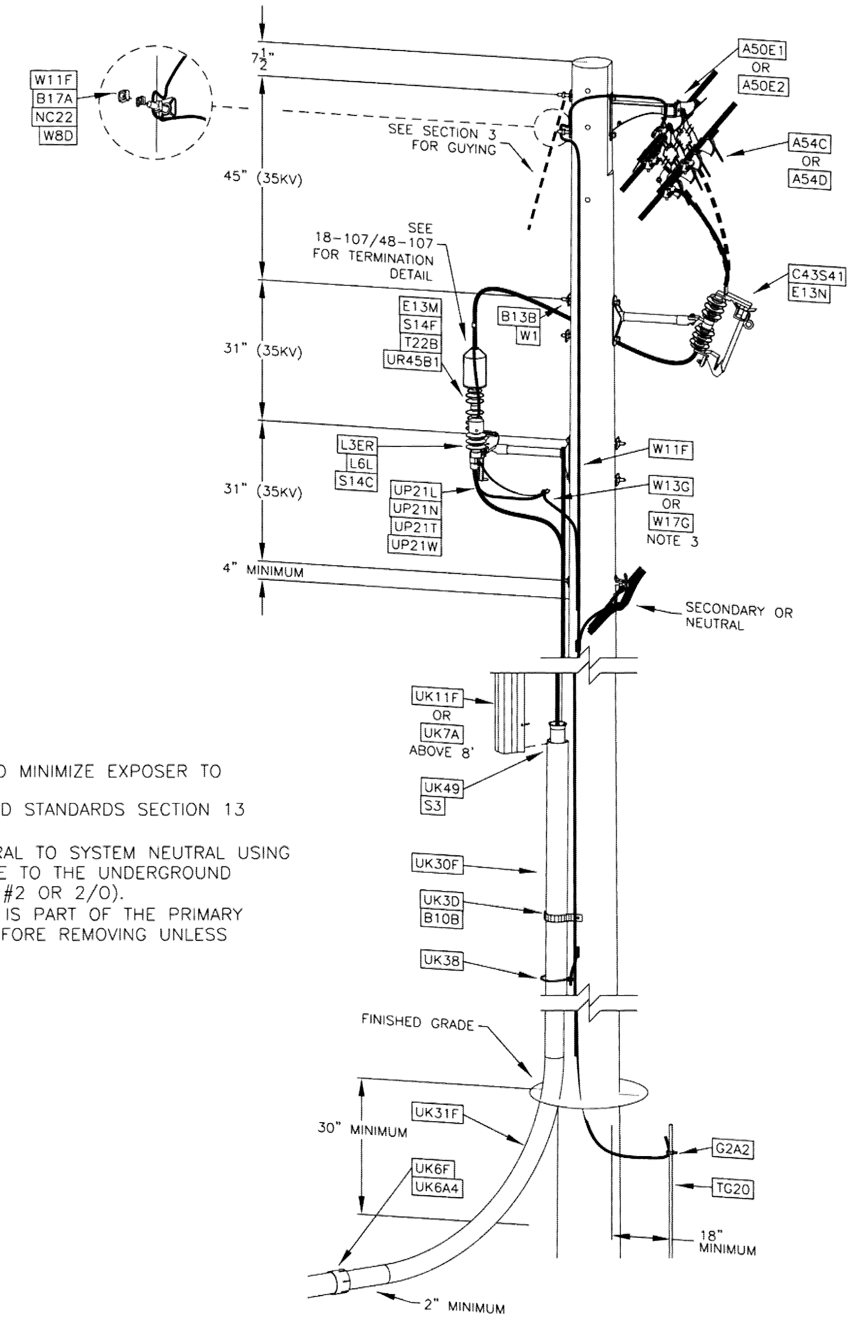
1. RISER SHALL BE ORIENTED TO MINIMIZE EXPOSER TO TRAFFIC AND PHYSICAL DAMAGE.
2. DOWN GROUND PER OVERHEAD STANDARDS SECTION 13 GROUNDING.
3. CONTINUE CONCENTRIC NEUTRAL TO SYSTEM NEUTRAL USING A CONDUCTOR OF EQUIVALENT SIZE TO THE UNDERGROUND CABLE CONCENTRIC NEUTRAL (I.E. #2 OR 2/0).
4. CAUTION – THIS DOWN LEAD IS PART OF THE PRIMARY NEUTRAL CONNECTION. JUMPER BEFORE REMOVING UNLESS CUTOUT IS OPEN.

Supersedes 7/18 Issue -Updated Item T22B

SINGLE PHASE SPACER CABLE RISER - 15KV

ISSUE	PAGE NUMBER		
7/19	18-400	OVERHEAD CONSTRUCTION STANDARD	ppl

SEE PAGE 18-125M FOR MUS



NOTES:

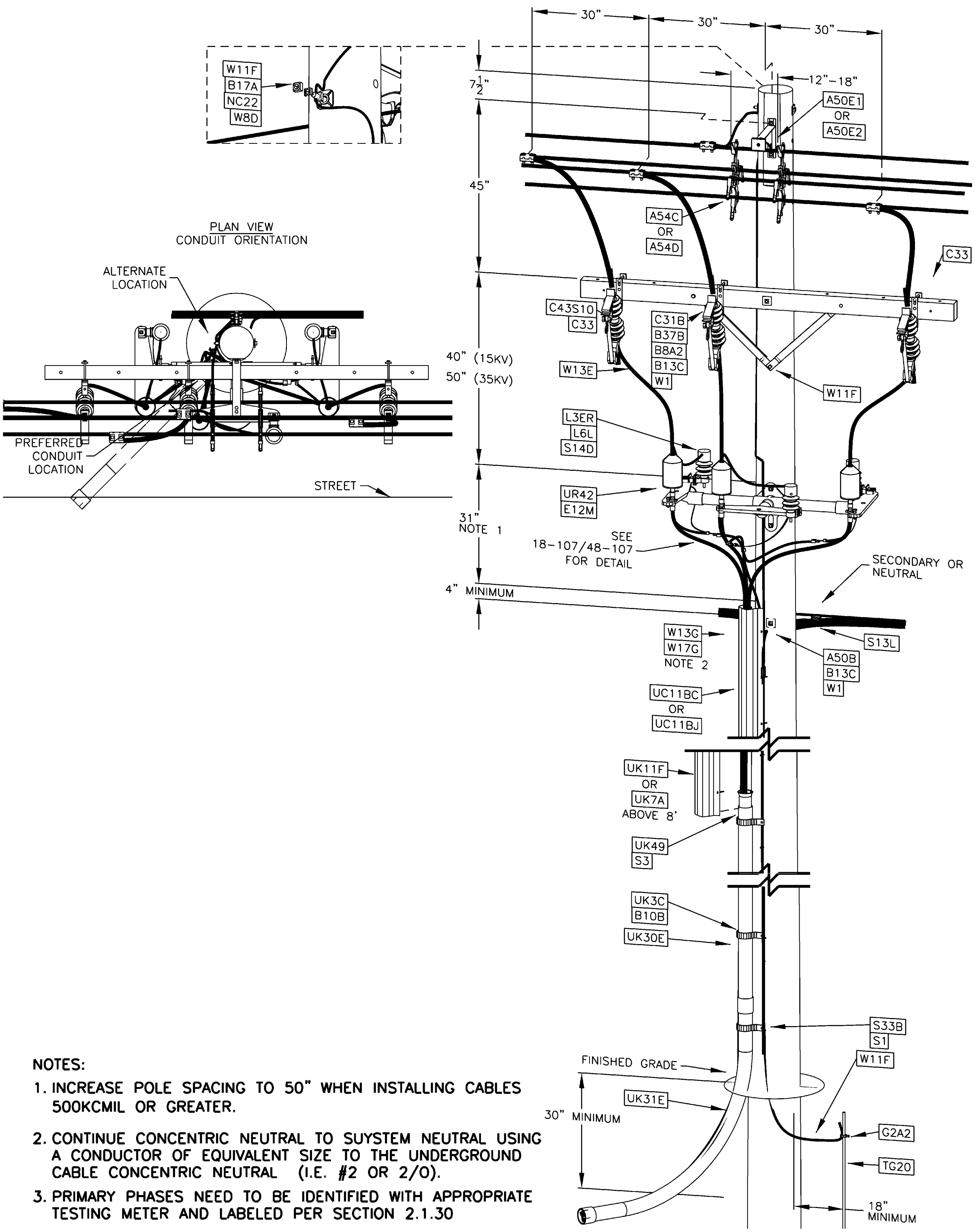
1. RISER SHALL BE ORIENTED TO MINIMIZE EXPOSER TO TRAFFIC AND PHYSICAL DAMAGE.
2. DOWN GROUND PER OVERHEAD STANDARDS SECTION 13 GROUNDING.
3. CONTINUE CONCENTRIC NEUTRAL TO SYSTEM NEUTRAL USING A CONDUCTOR OF EQUIVALENT SIZE TO THE UNDERGROUND CABLE CONCENTRIC NEUTRAL (I.E. #2 OR 2/0).
4. CAUTION – THIS DOWN LEAD IS PART OF THE PRIMARY NEUTRAL CONNECTION. JUMPER BEFORE REMOVING UNLESS CUTOUT IS OPEN.

Designer	Drawing	Date
MPR	od18400M	12/3/18

Supersedes 7/18 Issue -Updated Item T22B

SINGLE PHASE SPACER CABLE RISER - 35KV
MAINTENANCE ONLY

SEE PAGE 18-126 FOR MUS



Supersedes 7/19 Issue – Note 3 added

NOTES:

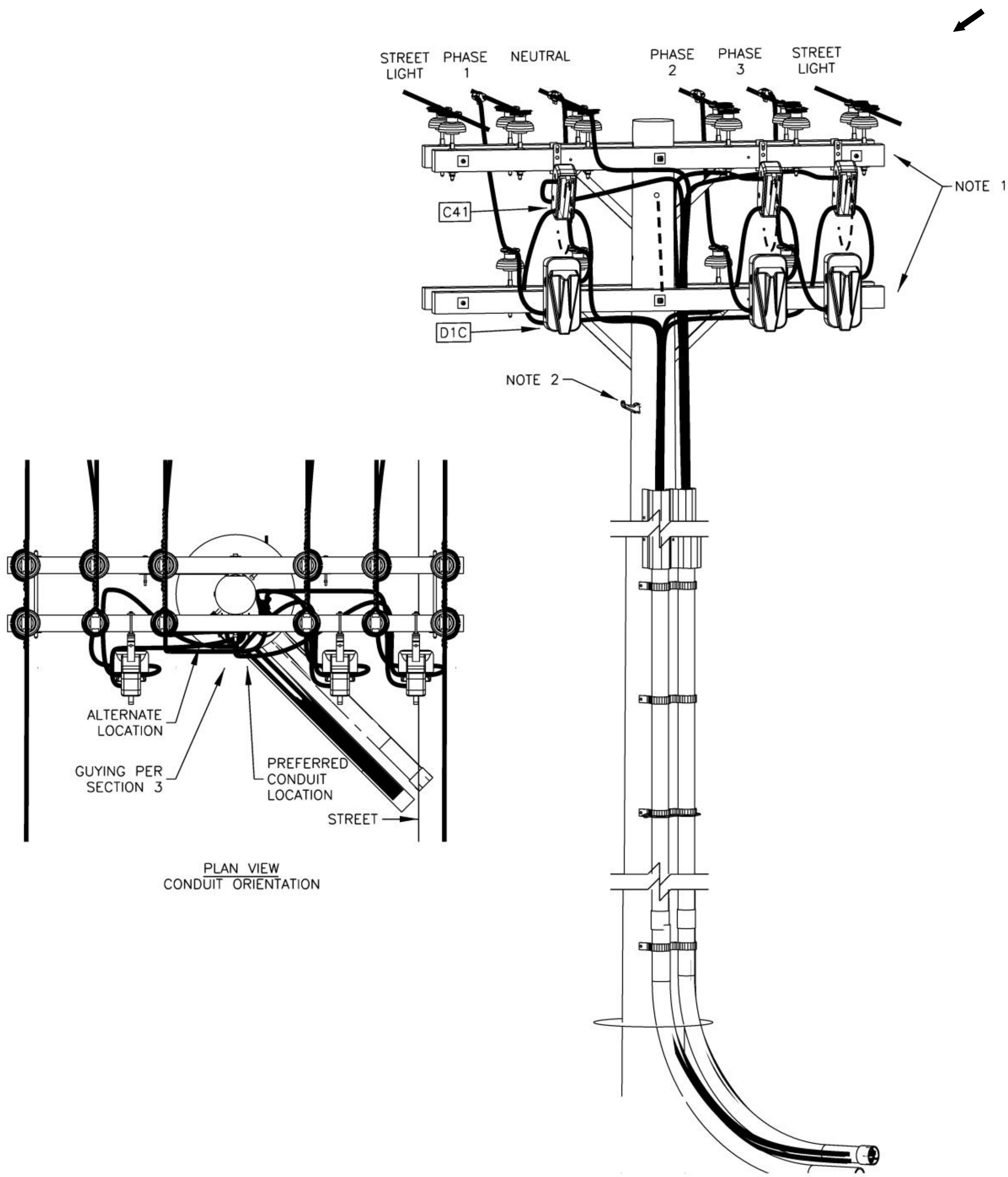
1. INCREASE POLE SPACING TO 50" WHEN INSTALLING CABLES 500KCMIL OR GREATER.
2. CONTINUE CONCENTRIC NEUTRAL TO SUYSTEM NEUTRAL USING A CONDUCTOR OF EQUIVALENT SIZE TO THE UNDERGROUND CABLE CONCENTRIC NEUTRAL (I.E. #2 OR 2/0).
3. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od18405	6/30/20

THREE PHASE SPACER CABLE RISER - 35kV MAXIMUM DISTRIBUTION

ISSUE	PAGE NUMBER		
7/20	18-405	OVERHEAD CONSTRUCTION STANDARD	ppl

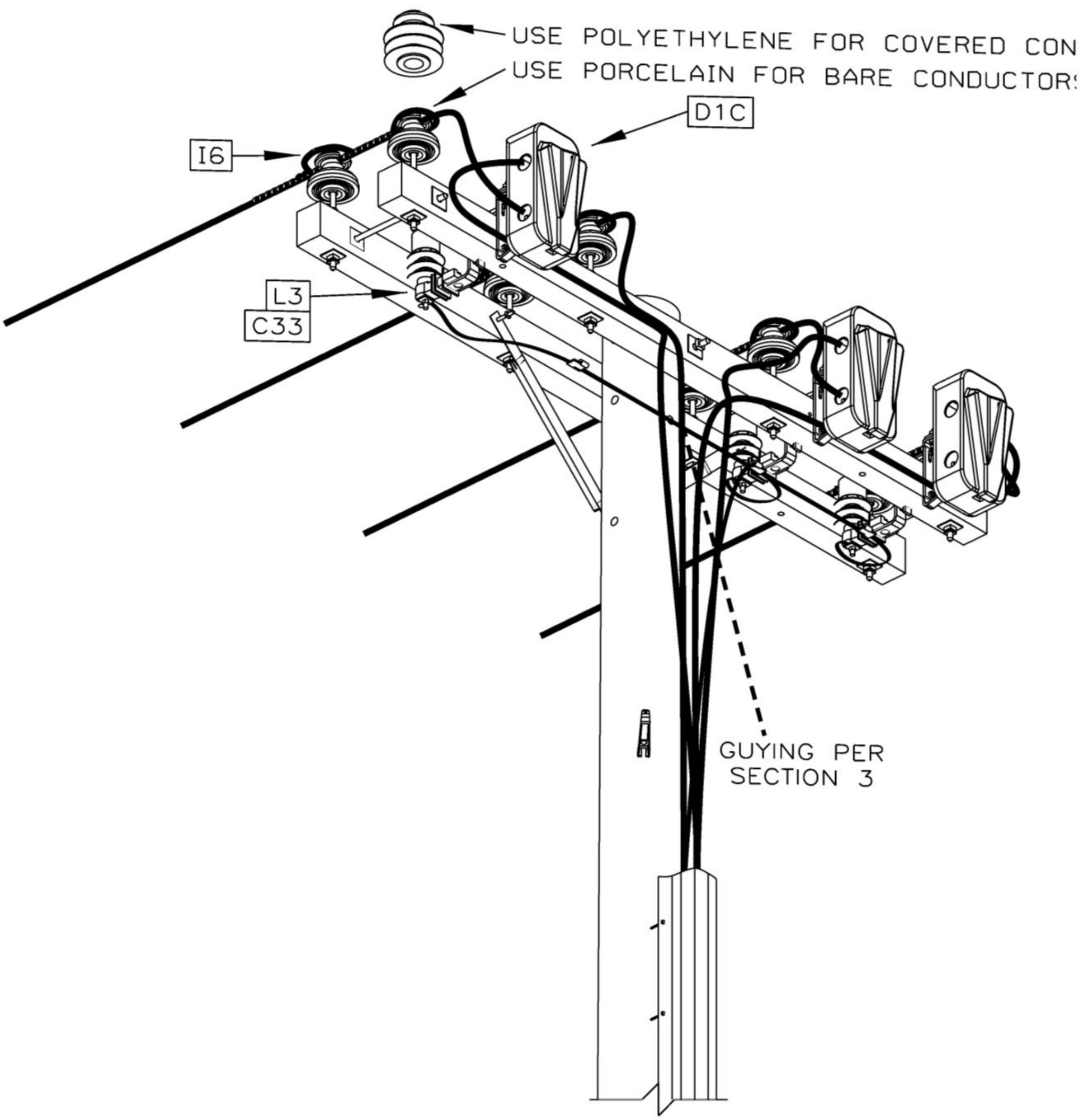
Supersedes 7/09 Issue - 3D Drawing Conversion



NOTES:
1. IN WIND AREAS USE SPREAD CONSTRUCTION ON TOP ARM AND PLACE STREET LIGHT WIRES ON BOTTOM ARM.
2. THIS DRAWING SHOWS GENERAL ARRANGEMENT ONLY. FOR DETAILS SEE DRAWINGS WD-237-B AND WD-237-C.
3. STEP POLE IN APPROVED MANNER.

Designer	Drawing	Date
MPR	od18734	6/26/18

UG URBAN AREA SECTIONALIZING RISER POLE WITH ENCLOSED CUTOUTS - FOR BACKYARD CONSTRUCTION **(MAINTENANCE ONLY)**

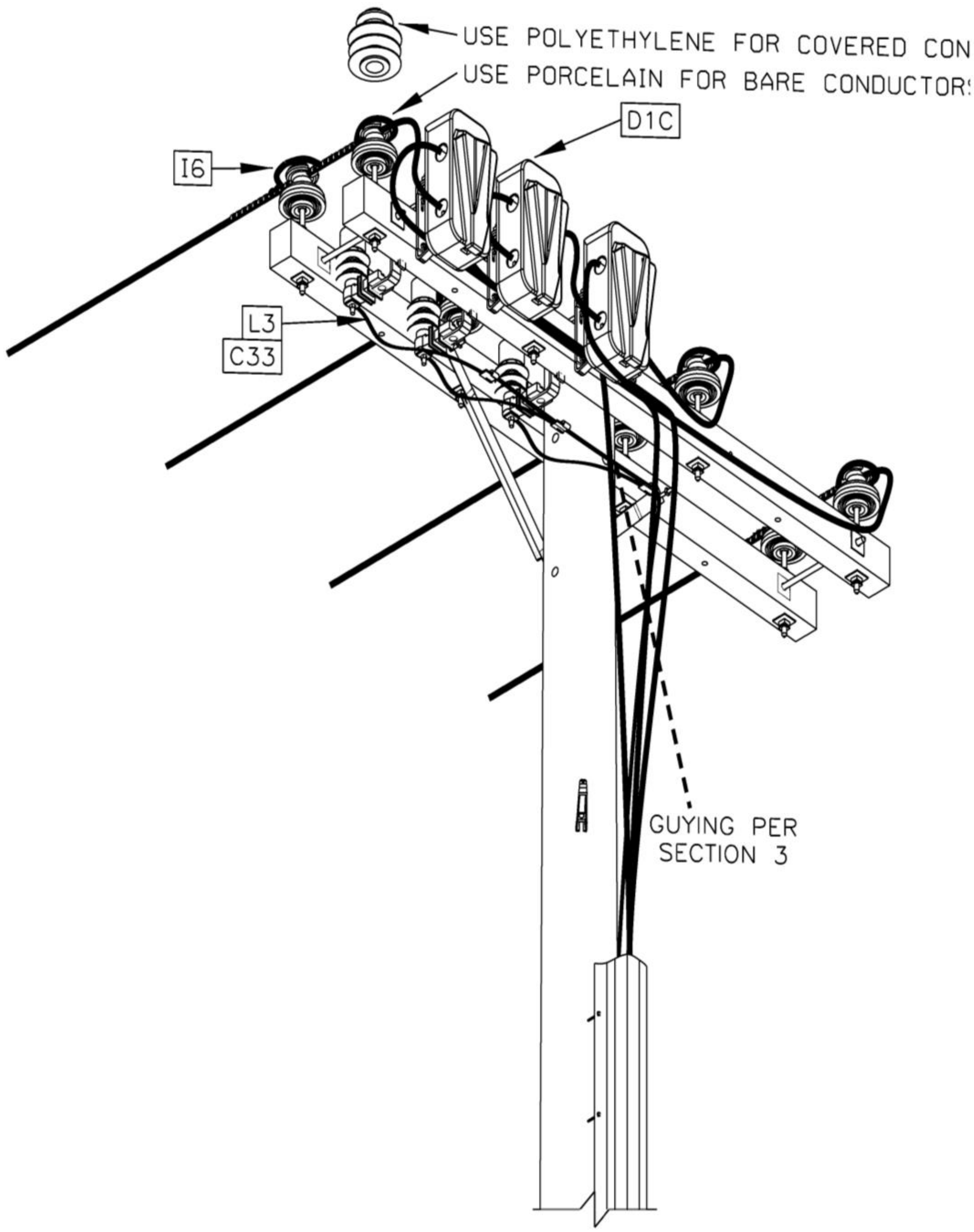


Supersedes 7/09 Issue - 3D Drawing Conversion

Designer	Drawing	Date
MPR	od18735	6/26/18

MAIN LINE WYE SYSTEM RISER POLE WITH ENCLOSED DISCONNECT SWITCHES - FOR BACKYARD CONSTRUCTION **(MAINTENANCE ONLY)**

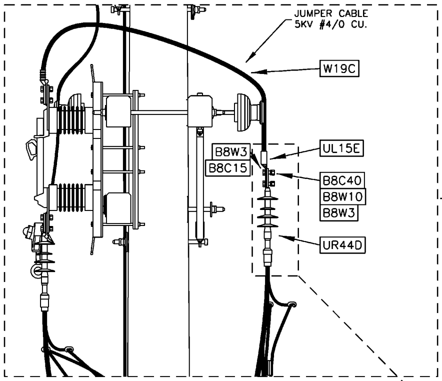
Supersedes 7/09 Issue - 3D Drawing Conversion



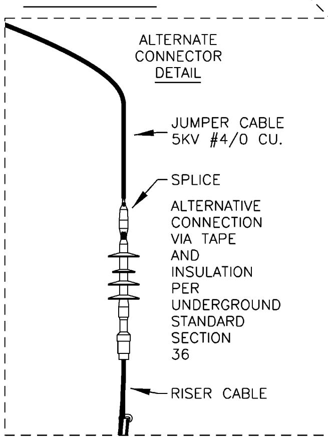
Designer	Drawing	Date
MPR	od18736	6/26/18

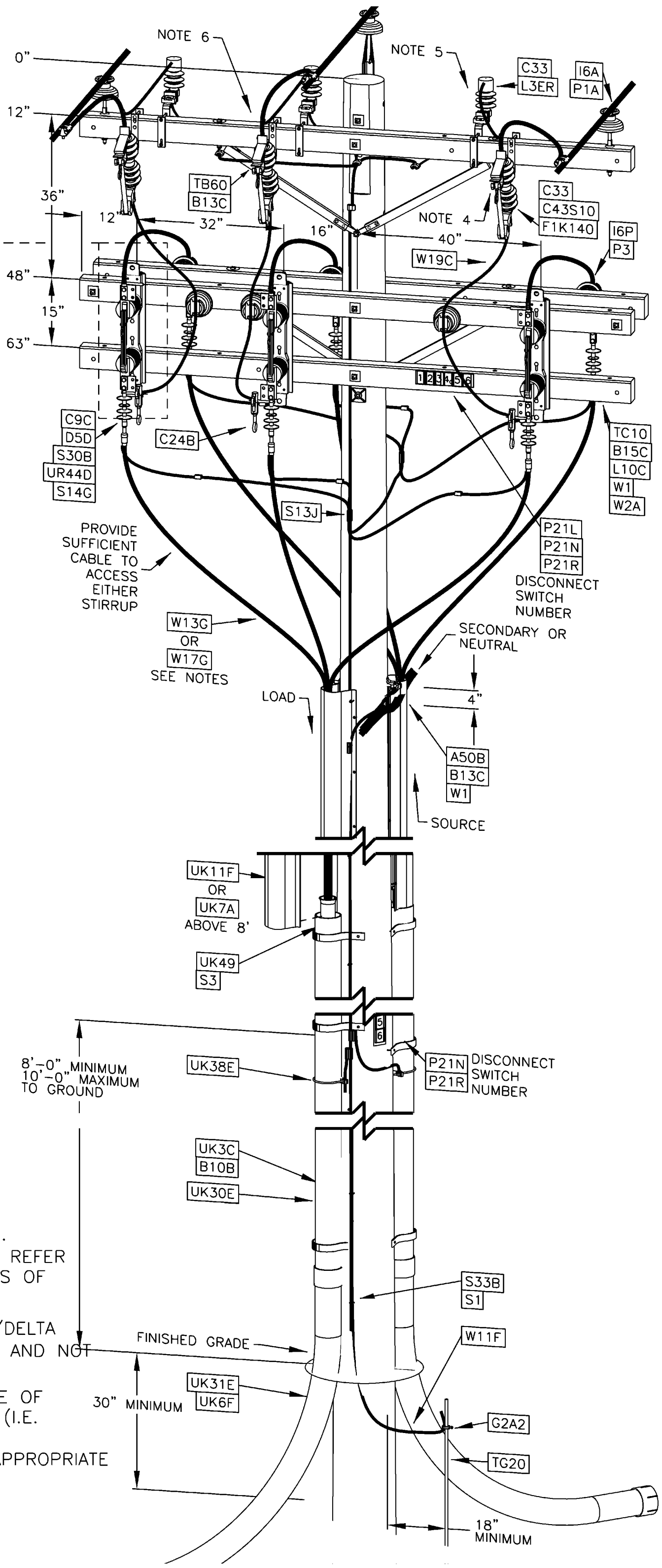
MAIN LINE DELTA SYSTEM RISER POLE WITH ENCLOSED DISCONNECT SWITCHES - FOR BACKYARD CONSTRUCTION **(MAINTENANCE ONLY)**

MU=@18737LBSW15KV(W)/(X)AF	3Ph Riser 600A LDBRK, 15KV, (W)=Underground Cable Size, A=500,B=750,C=1000



SWITCH DETAIL





Supersedes 7/19 Issue – Switch numbering on crossarm and note 7 added

RISER CABLE	MU (MACRO UNIT)
500 MCM	@18-737A/ Ⓟ AF
750 MCM	@18-737B/ Ⓟ AF

Ⓟ =FUSE AMPERAGE

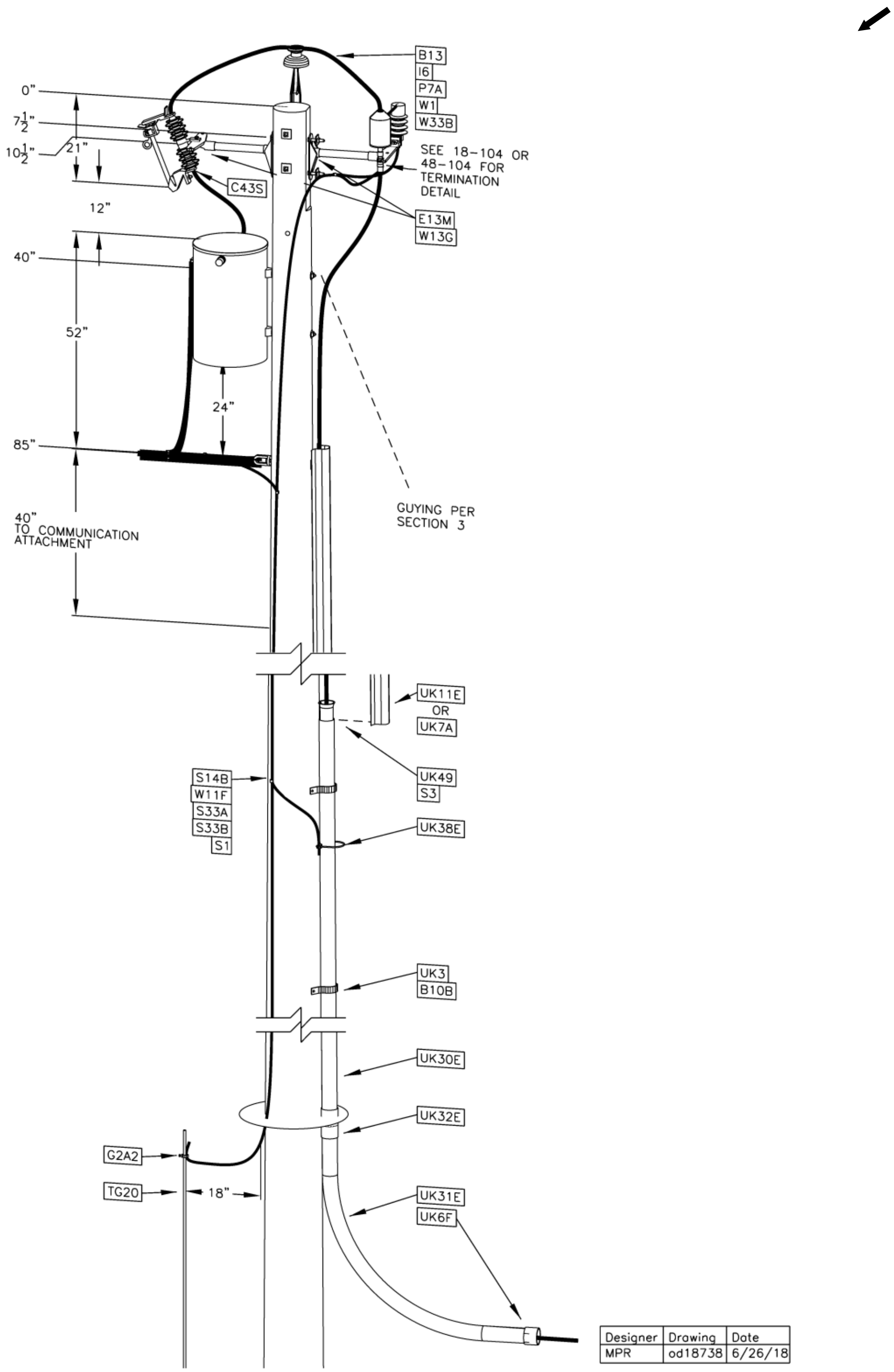
NOTES:

1. CONTINUE CONCENTRIC NEUTRAL TO SYSTEM NEUTRAL/DOWN GROUND USING A CONDUCTOR OF EQUIVALENT SIZE TO THE UNDERGROUND CABLE'S CONCENTRIC NEUTRAL.
2. TERMINATION DETAILS ARE SHOWN ON PAGE 5-148.
3. THIS ARRANGEMENT IS INTENDED FOR UNDERGROUND URBAN AREAS (SUCH AS DOWNTOWN BUFFALO) AND WHERE POLE SPACE IS LIMITED.
4. FUSED CUTOUTS ARE "FED" FROM THE BOTTOM. OPERATORS SHALL EXERCISE APPROPRIATE CAUTION. REFER TO SECTION 12.4 FOR SELECTION AND LOAD RATINGS OF CUTOUTS AND DISCONNECT SWITCHES.
5. ARRESTERS CONNECTED TO UNGROUNDED WYE/DELTA PRIMARY CIRCUITS MUST BE GROUNDED SEPARATELY AND NOT INTERCONNECTED TO THE NEUTRAL.
6. CUTOUTS MAY BE INSTALLED ON OPPOSITE SIDE OF CROSSARM OR ON ADJACENT POLE WHEN CLIMBING (I.E. POLE IS NOT BUCKET TRUCK ACCESSIBLE).
7. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od18737	6/30/20

MU @18-738-5KV
MU @18-738-5KVC

Supersedes 7/16-3D Drawing Conversion

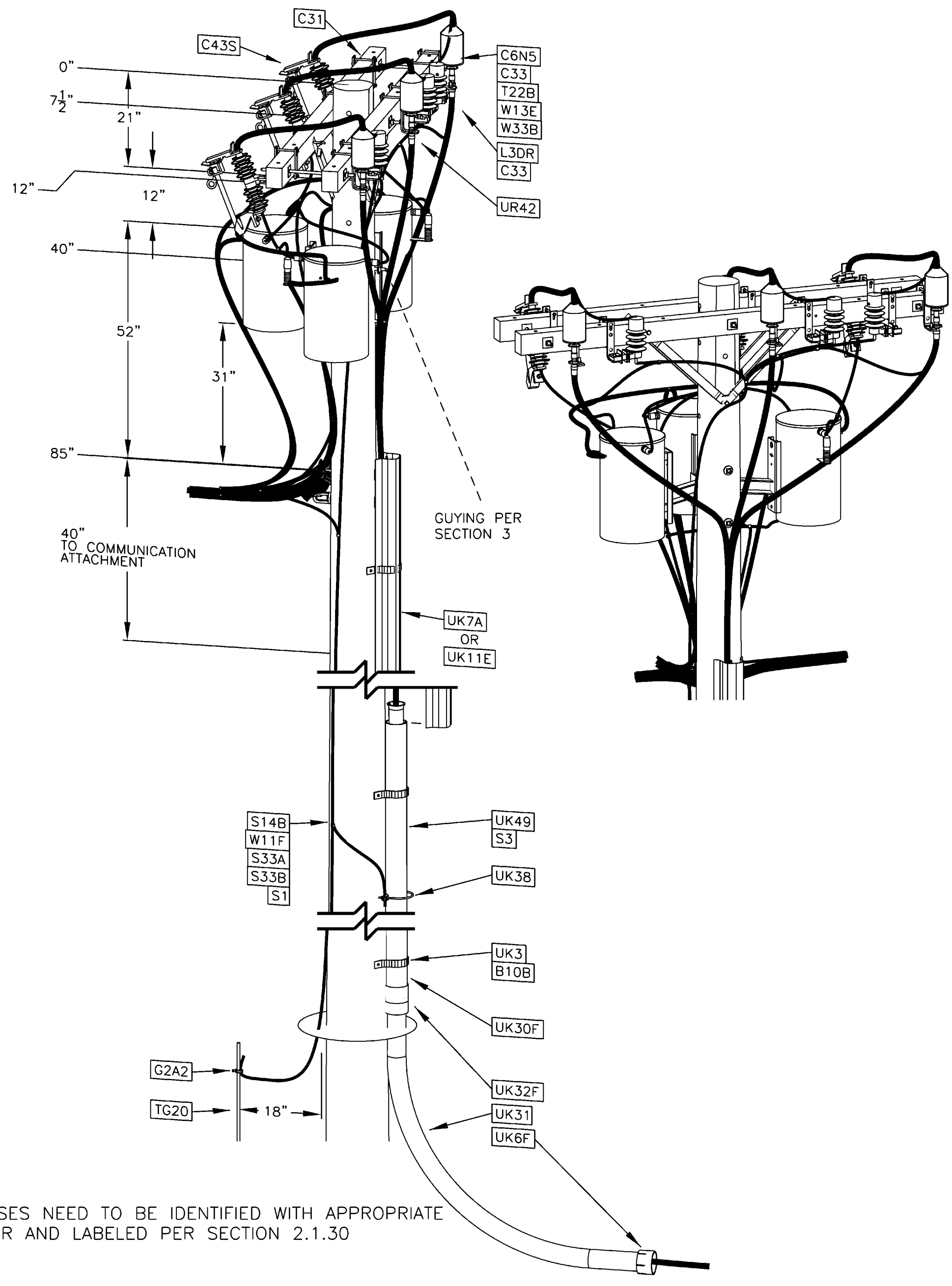


Designer	Drawing	Date
MPR	od18738	6/26/18

UG URBAN AREA SINGLE PHASE RISER WITH TRANSFORMER FOR BACKYARD CONSTRUCTION – 5KV

		PAGE NUMBER	ISSUE
ppl	UNDERGROUND CONSTRUCTION STANDARD	18-738	7/18

MU @18-739-5KV
MU @18-739-5KVC



NOTES:

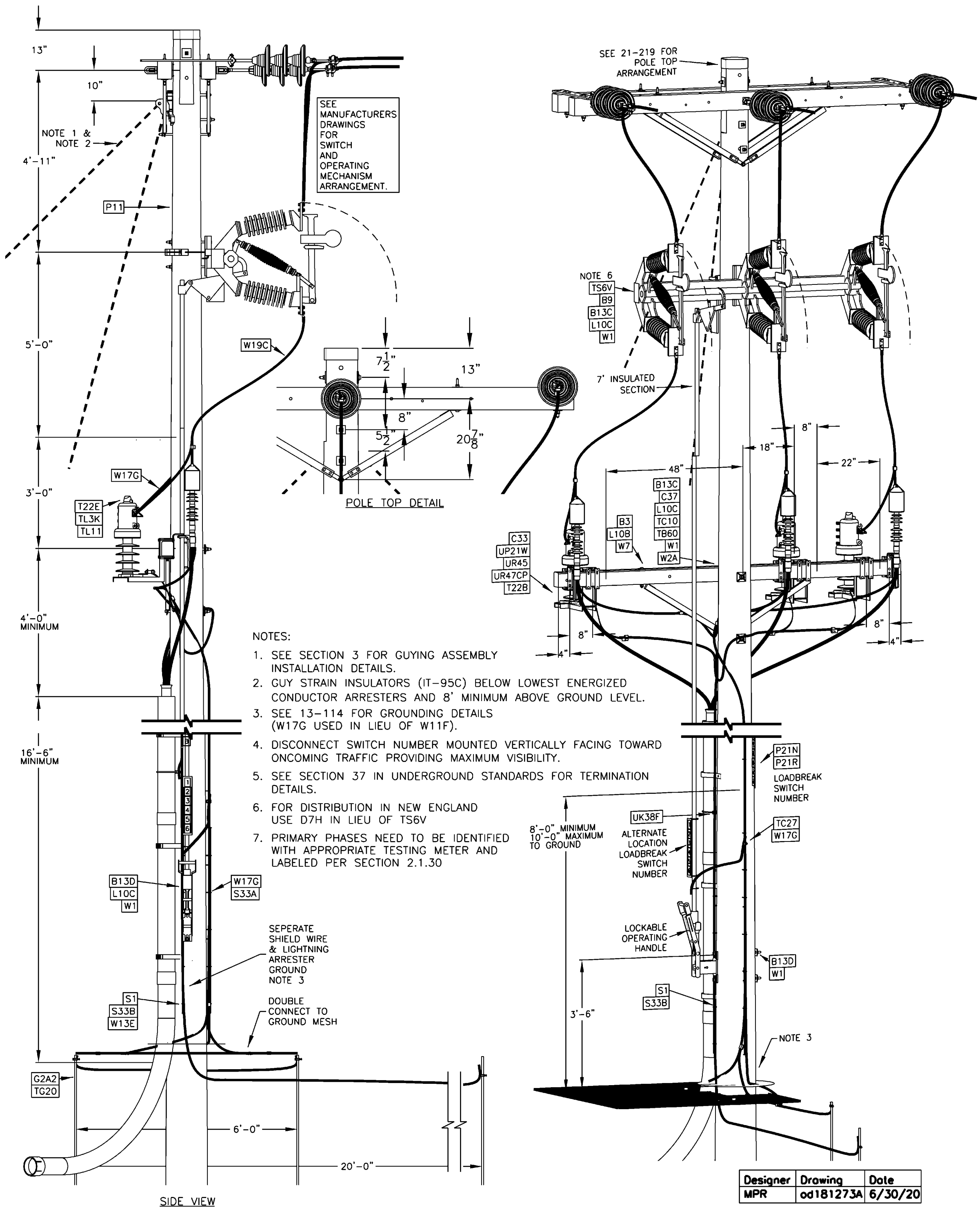
1. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od18739	6/30/20

Supersedes 7/18 Issue– Note 1 added

UG URBAN AREA THREE PHASE RISER WITH TRANSFORMERS - FOR BACKYARD CONSTRUCTION, 5kV			
ISSUE	PAGE NUMBER	UNDERGROUND CONSTRUCTION STANDARD	ppl
7/20	18-739		

MU=@18-1273A(X)KV(W)	3Ph Riser 600A LDBRK, 23/35KV, (W)=OH Conductor 1/0, 336 or 477

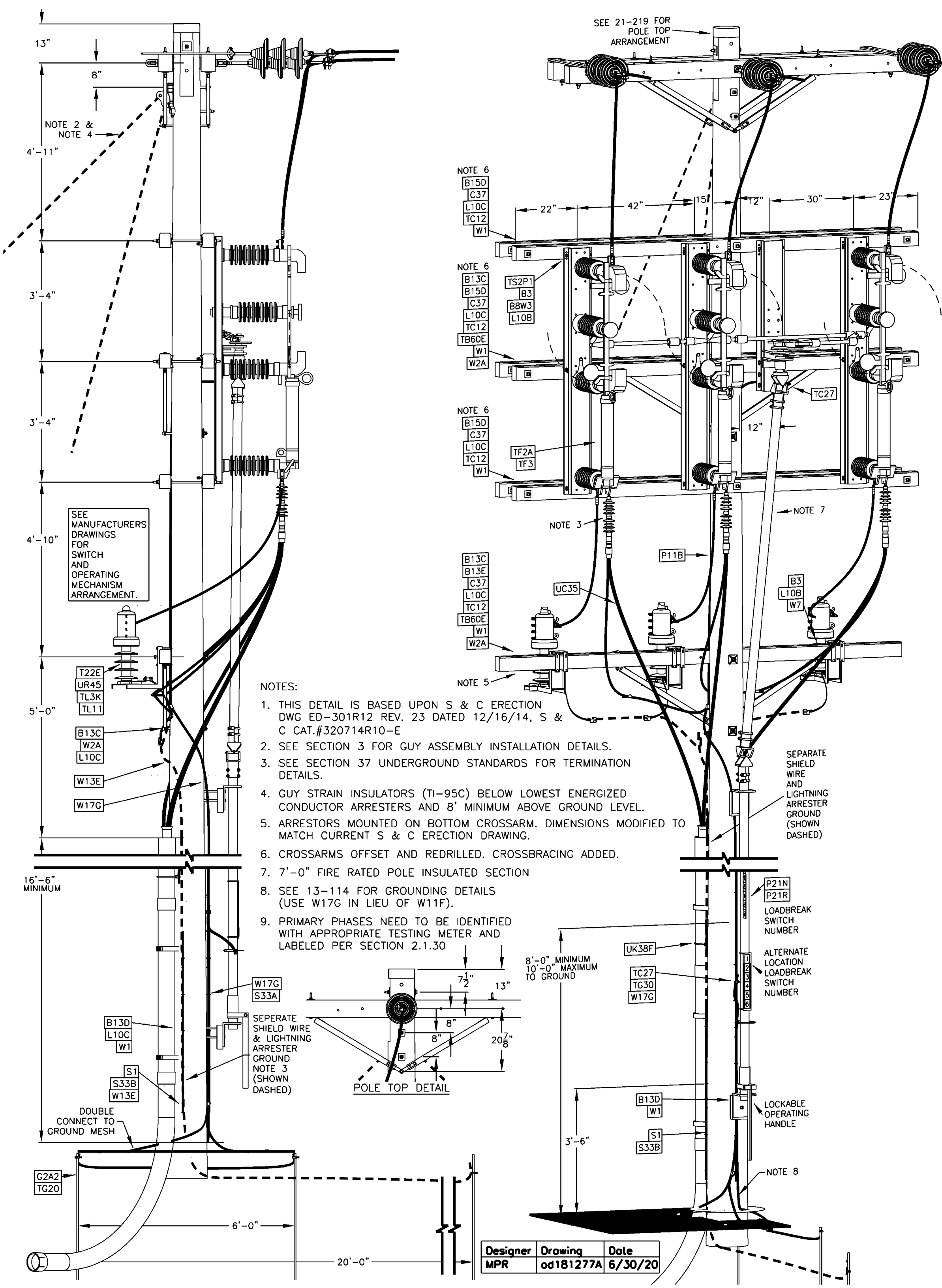


Supersedes Issue 7/19 – Note 7 added

SUB-TRANSMISSION RISER WITH VERTICAL LOADBREAK – 23/35KV

		PAGE NUMBER	ISSUE
ppl	UNDERGROUND CONSTRUCTION STANDARD	18-1273A	7/20

MU=@18-1277A35KV(W)	3Ph Riser 600A LDBRK, 35KV, (W)=OH Conductor 1/0, 336 or 477



NOTES:

1. THIS DETAIL IS BASED UPON S & C ERECTION DWG ED-301R12 REV. 23 DATED 12/16/14, S & C CAT.#320714R10-E
2. SEE SECTION 3 FOR GUY ASSEMBLY INSTALLATION DETAILS.
3. SEE SECTION 37 UNDERGROUND STANDARDS FOR TERMINATION DETAILS.
4. GUY STRAIN INSULATORS (TI-95C) BELOW LOWEST ENERGIZED CONDUCTOR ARRESTERS AND 8' MINIMUM ABOVE GROUND LEVEL.
5. ARRESTORS MOUNTED ON BOTTOM CROSSARM. DIMENSIONS MODIFIED TO MATCH CURRENT S & C ERECTION DRAWING.
6. CROSSARMS OFFSET AND REDRILLED. CROSSBRACING ADDED.
7. 7'-0" FIRE RATED POLE INSULATED SECTION
8. SEE 13-114 FOR GROUNDING DETAILS (USE W17G IN LIEU OF W11F).
9. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

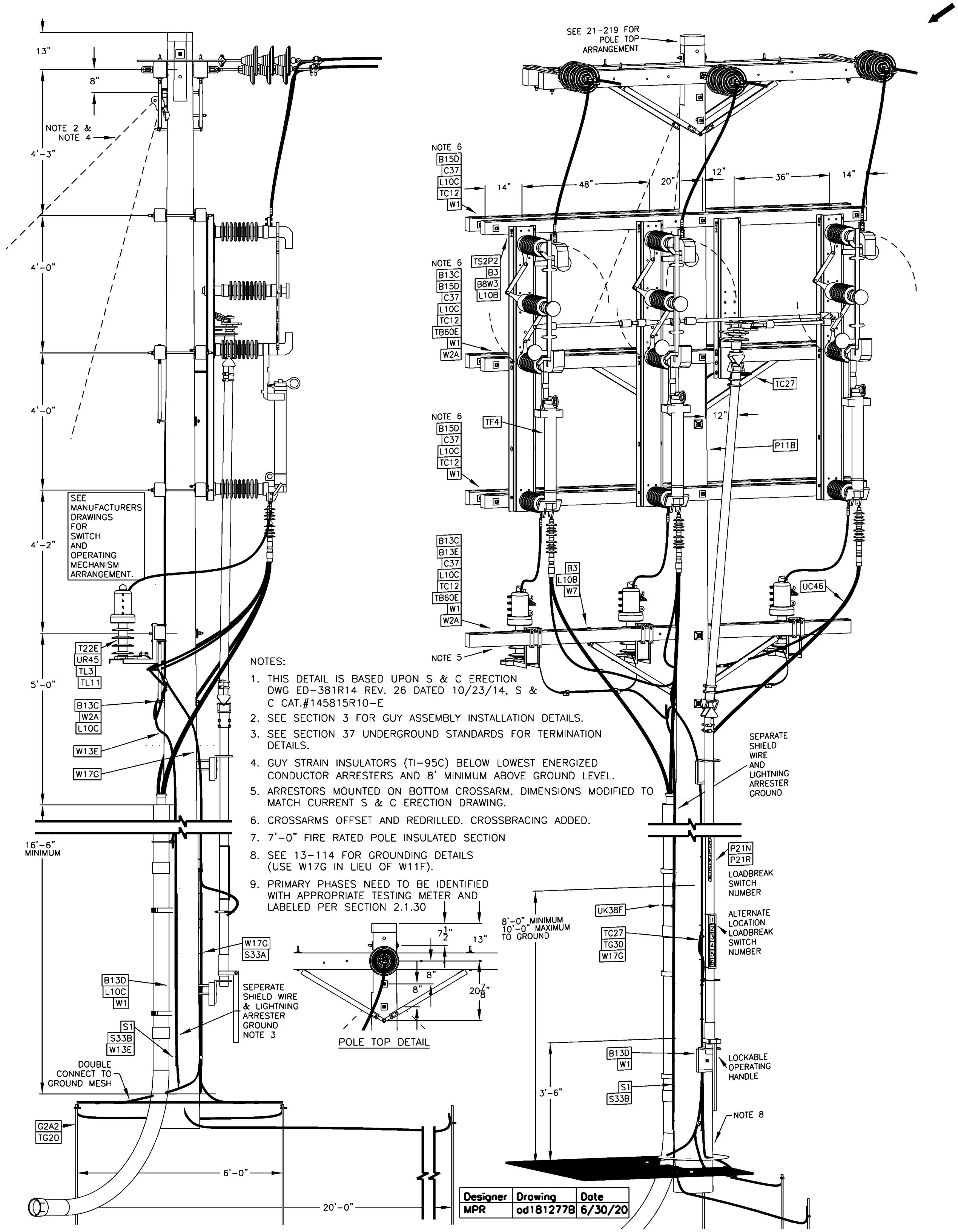
Designer	Drawing	Date
MPR	od181277A	6/30/20

Supersedes 7/19 Issue– Clarified arrestor grounding and added note 9

SUB-TRANSMISSION RISER WITH LOADBREAK/POWER FUSE – 35KV

MU=@18-1277B46KV(W)	3Ph Riser 600A LDBRK, 46KV, (W)=OH Conductor 1/0, 336 or 477

Supersedes 7/19 Issue- Note 9 added



NOTES:

1. THIS DETAIL IS BASED UPON S & C ERECTION DWG ED-381R14 REV. 26 DATED 10/23/14, S & C CAT.#145815R10-E
2. SEE SECTION 3 FOR GUY ASSEMBLY INSTALLATION DETAILS.
3. SEE SECTION 37 UNDERGROUND STANDARDS FOR TERMINATION DETAILS.
4. GUY STRAIN INSULATORS (TI-95C) BELOW LOWEST ENERGIZED CONDUCTOR ARRESTERS AND 8' MINIMUM ABOVE GROUND LEVEL.
5. ARRESTORS MOUNTED ON BOTTOM CROSSARM. DIMENSIONS MODIFIED TO MATCH CURRENT S & C ERECTION DRAWING.
6. CROSSARMS OFFSET AND REDRILLED. CROSSBRACING ADDED.
7. 7'-0" FIRE RATED POLE INSULATED SECTION
8. SEE 13-114 FOR GROUNDING DETAILS (USE W17G IN LIEU OF W11F).
9. PRIMARY PHASES NEED TO BE IDENTIFIED WITH APPROPRIATE TESTING METER AND LABELED PER SECTION 2.1.30

Designer	Drawing	Date
MPR	od181277B	6/30/20

SUB-TRANSMISSION RISER WITH LOADBREAK/POWER FUSE – 46KV

ppl	UNDERGROUND CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		18-1277B	7/20

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Version	Date	Modification	Author(s)	Approval by (Name/Title)
12	7/21	• Added Drawing: 18-124A • Revised Drawings: 18-127, 18-336 & 18-336D		
11	7/20	• Revised Drawings: 18-004, 18-109, 18-110, 18-126, 18-126D, 18-127, 18-128, 18-335, 18-336, 18-336D, 18-337, 18-338, 18-340, 18-341, 18-353, 18-370, 18-405, 18-737, 18-739, 18-1273A, 18-1277A, 18-1277B		
10	7/19	• Revised Drawings: 18-112, 18-124M, 18-125M, 18-126, 18-126D, 18-335, 18-336, 18-336D, 18-337, 18-340, 18-341, 18-353, 18-400, 18-400M, 18-737, 18-1273A, 18-1277A & 18-1277B		
9	7/18	• 3D Drawing Conversions 18-104 – 18-337 & 18-340 – 18-738 & 18-1273A – 18-1277B • 3D Drawing Conversions for figures 1 and 2		
8	7/17	• Revised Index • New Standard 18-126D • New Standard 18-136D • Revised Standard 18-336 • New Standard 18-338 • Revised Standard 18-1273A		
7	7/16	• Revised Pages 18-4 and 18-6. • Updated Drawings 18-115B, 18-118, 18-127, 18-336, 18-337, 18-340 and 18-370 • New Std. 18-738 • New Std. 18-739 • New Std. 18-1273A • New Std. 18-1277A • New Std. 18-1277B		
6	7/15	• Text edits in 18.5 • Revised drawing reference 18.9 • Minor text change in title block 18-115B • Drawing change 18-124 • Added grounding clips to 18-400, 18-400M and 18-405.		
5	7/14	• Minor text change to Stds 18-109, 18-110, 18-112, 18-115, 18-116, 18-117, 18-118, 18-124, 18-128 & 18-336. • New Std 18-115B		
4	7/13	• Minor text change to stds 18-109, 18-110 and 18-111. • Revised Std 18-124 & 18-124M • Revised std 18-128. • Added note for pole spacing for stds 18-		

		126, 18-127, 18-128, 18-335, 18-336, 18-337, 18-340 and 18-353. • Added new standard 18-341		
3	7/12	• Minor text change for 18-111, 18-112 and 18-336 • Std 18-128 is being reviewed for clearances and position of riser brackets. • New Std 18-370 for sub-station risers		
2	7/11	• Added requirement for ground rod placement (18" from center of pole) on drawings where the ground rod is shown. • Removed guy wire materials on drawings where guys are shown - refer to Section 3 for all guying requirements. • Minor editorial corrections in the text portion of the section. • Corrected animal guard placement on most drawings where terminations are shown.		
1	7/09	• Text portion of the section has been completely re-written in order to combine what was previously in Section 18 and Section 18. • Updates were made to all drawings that were previously in Section 18. Some of the drawings that had previously been in Section 18 are now in this section. • Brand new drawings were introduced - particularly 18-112, 18-124M, 18-125M, 18-340, and 18-400M. • Many of the CUs and MUs listed on the drawings have either been added or updated.		

Supersedes 7/15 Issue – Revised Section numbers and page numbers.

19.0 GENERAL

This Standards section provides installation details about all types of outdoor lighting installations installed on wooden distribution poles throughout the Company service territory. The intent is to provide the user with a basic knowledge of the limitations and capabilities of the luminaires offered by the Company that can be passed on to customers as an aid in selecting the luminaire that will best meet their lighting need. This is not intended to be a substitute for a formal lighting layout.

19.0.10 Light Sources

All of the Company's luminaires use the following lamp sources.

Table 1
Lamp Sources

Light Source	Color Output	Comment
Mercury Vapor (MV)	Blue / White	Obsolete light source. Luminaires can no longer be purchased. Lamps are available for maintenance of existing installations.
High Pressure Sodium Vapor (HPS)	Orange	Most efficient light source used for all general illumination requirements.
Probe Start Metal Halide (MH)	White	Obsolete light source. Luminaires can no longer be purchased. Lamps are available for maintenance of existing installations.
Pulse Start Metal Halide (PSMH)	White	Used where light output color is a primary concern.
Light-Emitting Diode (LED)	White	Approved for use in roadway applications only in towns with tariff agreements. This source will eventually become predominant luminaire.

19.0.20 Lighting Controls

Company luminaires are designed for dusk to dawn operation using photoelectric controls. Photoelectric controls are factory calibrated to "turn on" the luminaire when the natural light level falls to 1.5 foot-candles. This occurs at approximately 16 minutes after sunset and results in approximately 4,175 luminaire burning hours per year.

19.0.30 Horizontal Roadway Luminaires

Horizontal roadway luminaires are designed for roadway illumination applications. A horizontal roadway luminaire will produce an oval shaped light pattern designed to throw the light output up and down the roadway a greater distance than across the roadway. The area a horizontal roadway luminaire can cover is directly dependent on the mounting height of the luminaire.

19.0.40 Floodlight Luminaires

Floodlight luminaires are designed to meet the needs of non-roadway illumination applications. They are designed to focus a high level of illumination on a specific area. Their primary application is commercial and industrial security lighting.

19.0.50 Private Area Luminaires

Private area luminaires are general purpose luminaires designed for non-roadway illumination applications. They produce a circular light pattern in a small concentrated area. These luminaires are primarily designed for residential security applications.

19.0.60 Teardrop Luminaires

Teardrop luminaires are decorative luminaires designed for roadway illumination applications. They are mounted at a nominal 25 foot height and produce an oval shaped light pattern identical to horizontal roadway luminaires. Specific decorative poles are available to complement the historic teardrop luminaire style.

19.1 DEFINITIONS

Table 2
Commonly Used Outdoor Lighting Terms Defined

TERM	DEFINITION
Air Lamp:	A failure mode for a high intensity discharge lamp where the vacuum is lost within the glass bulb and the lamp becomes filled with air.
Arc Tube:	A gas filled glass tube within a high intensity discharge lamp that gives off illumination when energized with an electric current.
Ballast Transformer:	An auxiliary device used with a high intensity discharge lamp to obtain necessary circuit conditions for starting and operating the lamp. Reactor Ballast = A single winding ballast transformer. CWA Ballast **= C**onstant-**W**attage **A**utotransformer. = A two winding ballast transformer.
Bird Guard:	A device in a horizontal roadway luminaire used to prevent birds and squirrels from entering the luminaire housing.
Bracket:	A device installed on a wooden distribution pole which is used to extend and hold a luminaire out over a roadway surface.
Bulb:	The glass envelope component of a lamp.
Button Control:	A photoelectric control used in a decorative luminaire where only the light sensing device is visible from the outside of the luminaire.
Cobra-Head:	Another name for a horizontal roadway luminaire.
Cutoff: • *(non-cutoff)* • *(semi-cutoff)* • *(cutoff)* • *(full cutoff)*	An IES term used to describe how much illumination an outdoor luminaire allows to go skyward.
Cycling:	A failure mode of a high pressure sodium vapor lamp where the lamp continuously cycles “on” and “off”.
Effective Projected Area: (EPA)	A measurement in square feet to describe the area of a luminaire with respect to wind displacement.
NEMA:	National Electrical Manufacturers Association.
NEMA Luminaire:	A type of luminaire commonly used in rural or residential security lighting installations.
Optical Assembly:	The refractor and reflector components of a luminaire that control the illumination output.
PECR:	Photo-Electric Control Receptacle.
Photoelectric control: (PEC)	A device that switches luminaires on or off in response to natural light levels.
Photometrics:	A description of illumination output qualities and characteristics of a luminaire.
Red Cap:	A device used in place of a twistlock photoelectric control to leave the lamp load permanently “off”.
Reflector:	A surface of polished or painted metal, mirrored glass, or plastic, shaped to control and re-direct the illumination output.
Restrike Time:	The amount of time needed for an HID lamp source to restart after a momentary interruption in electrical power.
Shorting Receptacle Cap:	A device used in place of a twistlock photoelectric control to leave the lamp load permanently “on”.
Slipfitter:	The portion of a luminaire whose purpose is to attach the luminaire to an arm or bracket.

TERM	DEFINITION
Starter:	An electronic device utilized to provide voltage and current for initial illumination of an HID lamp.
Vandal Shield:	An accessory device used on an outdoor luminaire to provide protection from vandalism.
Visor:	An accessory device used on an outdoor luminaire to restrict and limit the outer limits of the illumination output.

19.2 IES LIGHT DISTRIBUTION PATTERNS

The Illuminating Engineering Society (IES) has a three part system to define the light output pattern of horizontal roadway, post top, and other luminaires commonly used in roadway lighting service.

19.2.10 Spacing Classification

This defines how far up and down the length of the roadway the luminaire can cover. This distance is expressed as a factor of the mounting height (MH) of the luminaire.

Table 3

Spacing Classification	Length of Main Beam	Maximum Pole Spacing
SHORT	1.0 to 2.25 MH	4.5 MH
MEDIUM	2.25 to 3.75 MH	7.5 MH
LONG	3.75 to 6.0 MH	12.0 MH

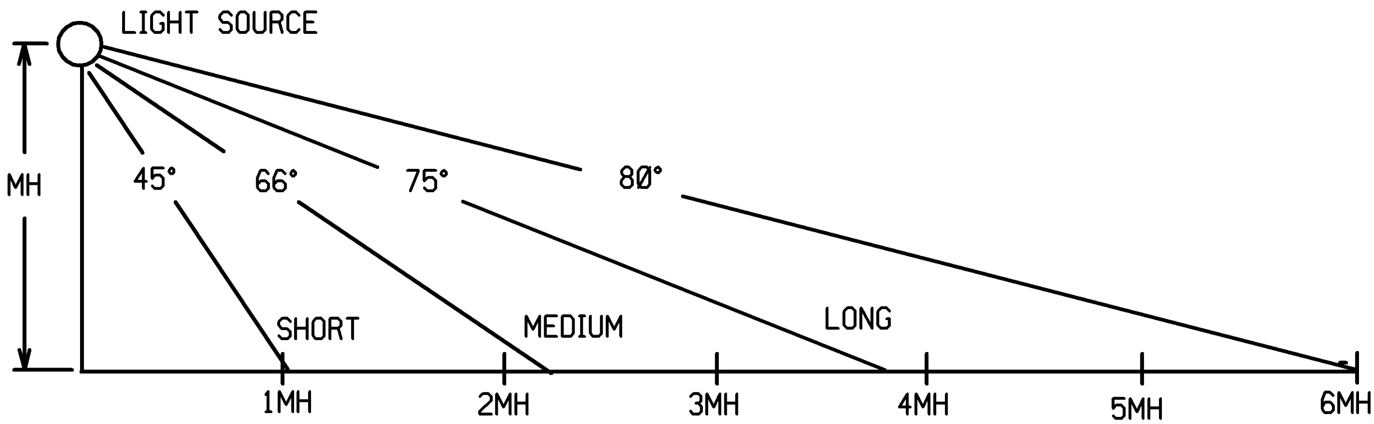


Figure 1
IES Spacing Classification

19.2.20 Glare Control Classification

The glare control classification defines how much of the light output is allowed to go above the 80 degree and 90 degree horizontal plane (skyward) of the luminaire.

Table 4

Glare Classification	Allowable Illumination Between the 80° and 90° Plane	Allowable Illumination Above the 90° Plane
FULL CUTOFF	< = 10 %	0 %
CUTOFF	< = 10 %	< = 2.5 %
SEMI-CUTOFF	< = 20 %	< = 5.0 %
NON-CUTOFF	no limitation	no limitation

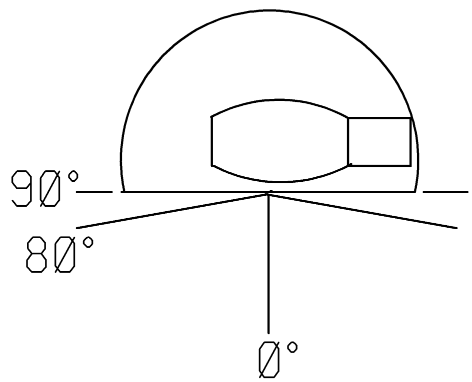


Figure 2
Glare Control Classification

19.2.30 **Width Classification**

This defines how far across the width of the roadway the main beam will shine. This distance is expressed as a factor of the mounting height (MH) of the luminaire.

Table 5

Width Classification	Definition
Type I	Intended to be located over the center of relatively narrow residential roadways.
Type II	Intended to be located near the side of a roadway not exceeding 1.75 MH in width.
Type III	Intended to be located near the side of a roadway not exceeding 2.75 MH in width.
Type IV	Intended to be located near the side of a roadway greater than 2.75 MH in width.
Type V	Provides a circular light pattern of equal intensity in all directions.

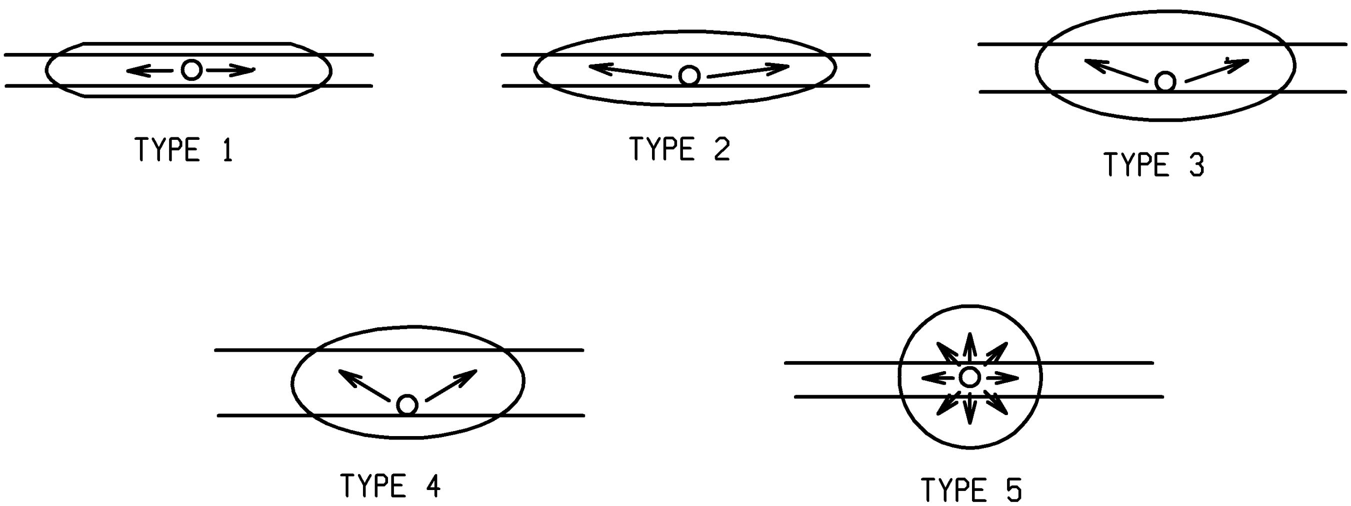


Figure 3
Width Classification

19.2.40 **Company Luminaires**

The IES Classification information for all luminaires used by the Company is found in STANDARDS Section 23 – Materials Catalog – Outdoor Lighting.

19.3 HORIZONTAL ROADWAY LUMINAIRES

This Section provides information for the proper application of horizontal roadway luminaires and other decorative pendant style luminaires with an IES type II or III distribution.

19.3.10 Mounting Height

Roadway luminaires must be installed at a sufficient height to minimize the glare to approaching traffic and at the same time provide an acceptable level of illumination at the roadway surface. The mounting height of a light source will affect the intensity of illumination, uniformity of brightness, area covered, and relative glare produced by the luminaire. Higher mounting heights will provide greater area coverage, more uniformity, and a reduction of glare, but a lower overall illumination level.

19.3.20 Overhead Supplied Installations

For lighting installations on wood distribution poles, the actual luminaire mounting height will be affected by other distribution equipment on the pole. In every case, adequate clearances, as specified in Construction Drawing 19-100, must be maintained. The roadway bracket rise will typically add 30 inches (±) to the luminaire mounting height as measured from the bracket through bolt height.

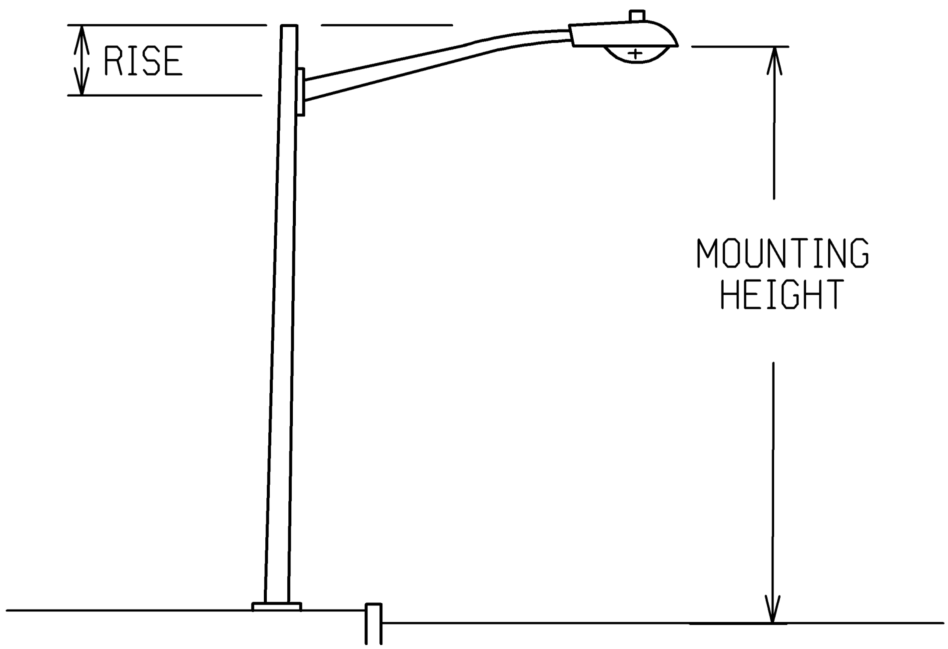


Figure 4
Luminaire Mounting Height

19.3.30 Recommended Minimum Roadway Luminaire Mounting Heights

Table 6

Luminaire Wattage	Minimum Mounting Height
50 Watt – 250 Watt	20 Feet
400 Watt	30 Feet
1,000 Watt	35 Feet

19.3.40 Arm / Bracket Length

The luminaire arm / bracket must have sufficient length to properly place the luminaire over the roadway surface in order to take best advantage of the luminaire light distribution pattern. Roadway luminaires with IES type II or III light distribution are designed to be mounted over the roadway surface near one side and still project useful light output across the entire roadway width. Common practice is to have the luminaire's refractor overhang the roadway surface by four feet.

19.3.50 To Determine Arm / Bracket Length

Add setback distance (determined by field measurement) to arm / bracket overhang distance (always 3 feet). The result will be the minimum arm / bracket length required. Installation of the luminaire will provide the additional distance needed to create a four foot overhang.

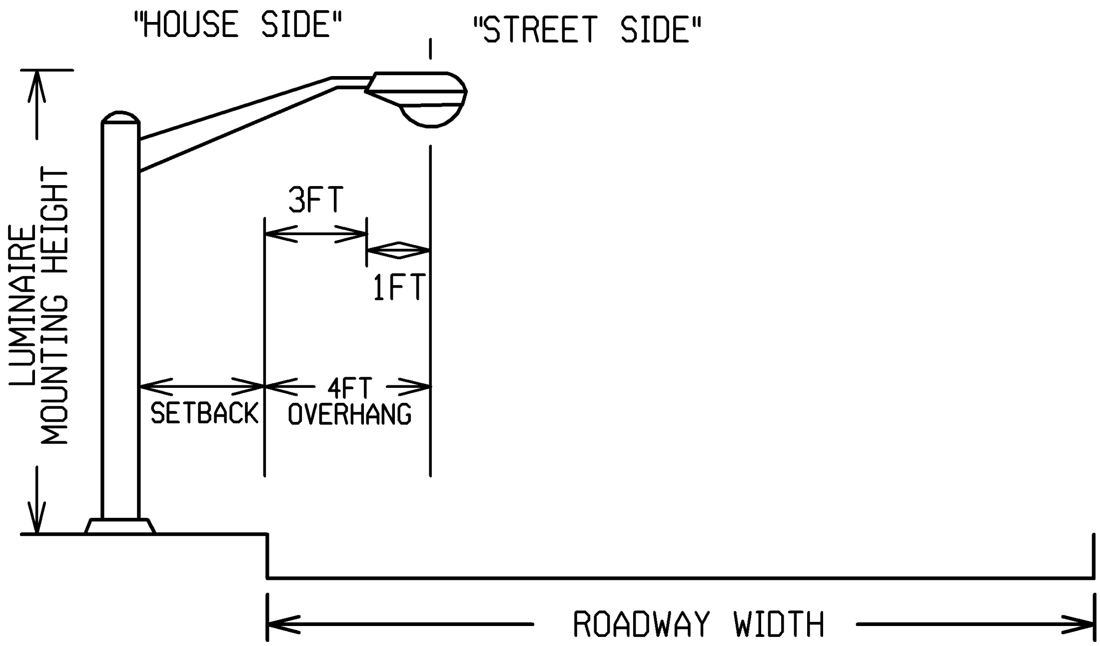


Figure 5
Arm / Bracket Length

19.3.60 Roadway Width

Roadway luminaires with an IES type II light distribution pattern are designed for roadways where the width does not exceed 1.75 times the luminaire mounting height. IES type III roadway luminaires are designed for roadway widths up to 2.75 times the luminaire mounting height.

If the roadway has multiple travel lanes or is divided, a roadway luminaire with Type II or Type III distribution will not be able to adequately illuminate the entire roadway width. A possible solution is to install luminaires on both sides of the roadway opposite one another.

19.3.70 Luminaire Adjustment

Tilting the luminaire five degrees upward will increase the "street side" illumination (and decrease the "house side" illumination). This may be a solution when a shorter arm / bracket must be used because of insufficient pole space or clearances.

19.3.80 Exceptions

Field conditions, such as trees, may necessitate using a different arm / bracket length than would normally be called for.

19.3.90 Luminaire Spacing

Luminaires should be spaced to allow the light output between adjacent luminaires to overlap. This will eliminate dark spots midway between two luminaires and contribute uniformity to the overall lighting installation.

19.3.100 Roadway Luminaire Selection

PPL offers horizontal roadway luminaires with semi-cutoff distribution (globe) and full cutoff distribution (flat glass). In the absence of specific direction from the customer, the default luminaire choice for horizontal roadway luminaires shall be the cutoff / full cutoff (flat glass) units.

19.4 FLOODLIGHT LUMINAIRES

This Section provides information for proper application of floodlight luminaires.

19.4.10 Mounting Height

Floodlight luminaires must be installed at a sufficient height in order to maximize the efficiency of the illumination output and at the same time control glare. The recommended mounting height for a floodlight luminaire is one half the distance across the area to be illuminated.

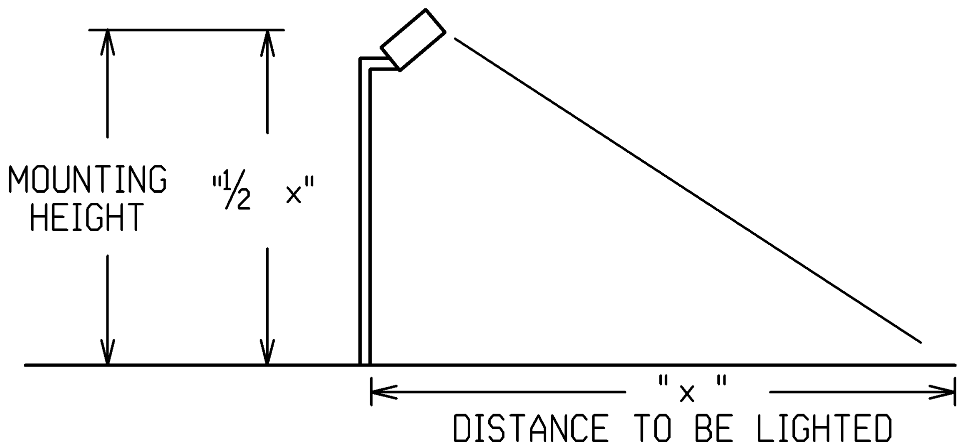


Figure 6
Floodlight Mounting Height

19.4.20 Clearance to Overhead Conductors

For floodlight installations mounted on wood distribution poles, the actual floodlight mounting height may be limited by other distribution equipment on the pole. In every case, adequate clearances, as specified in Construction Drawing 19-100, must be maintained.

19.4.30 Floodlight Aiming

Floodlight luminaires must be properly aimed in order to obtain the desired illumination. Some floodlight luminaires have a sight aiming guide molded into the top of the housing. Follow the manufacturer's instructions.

19.4.40 Vertical Aiming

Vertical floodlight aiming affects the distance a floodlight luminaire can cover. To maximize the useful light output, the floodlight should be aimed ⅔ across the distance to be lighted, or approximately two times the mounting height, whichever value is lower. To minimize glare, a floodlight's vertical aiming point distance should never exceed twice the mounting height. See Figure 7 for details.

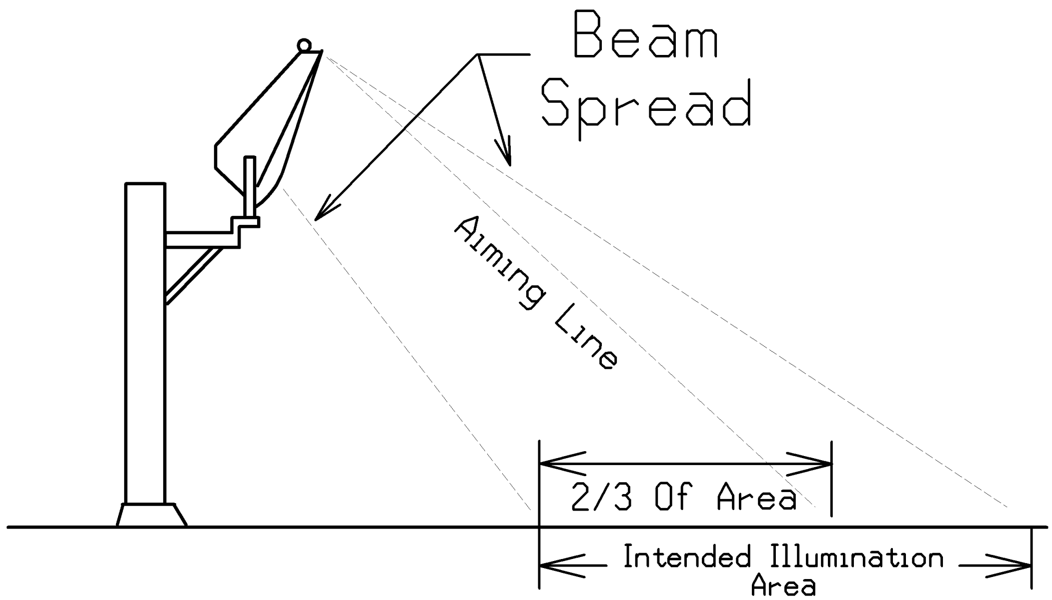


Figure 7
Floodlight Aiming – Vertical

19.4.50 Horizontal Aiming

Horizontal aiming must be considered when more than one floodlight is contributing to the illumination output. A floodlight's horizontal beam spread will extend 45 degrees on either side of the aiming line. Floodlight luminaires should be horizontally aimed to allow the light output between adjacent luminaires to overlap. This will contribute to overall uniformity to the overall lighting installation.

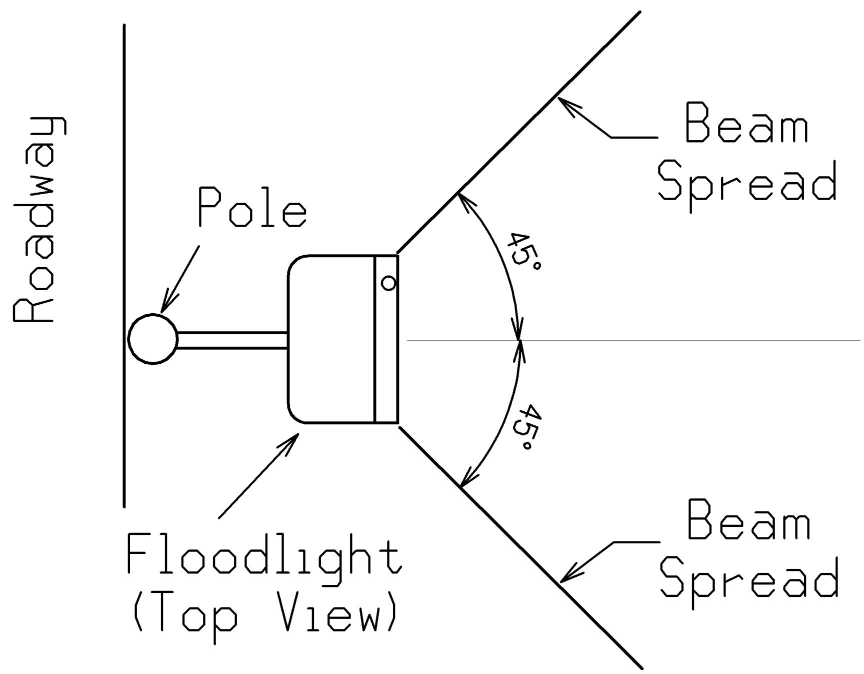


Figure 8
Floodlight Aiming – Horizontal

19.4.60 Pole Spacing

When a floodlighting installation consists of multiple luminaires mounted on different poles, pole spacing needs to be considered. In general, the spacing between adjacent floodlight poles should equal 4 times the luminaire mounting height.

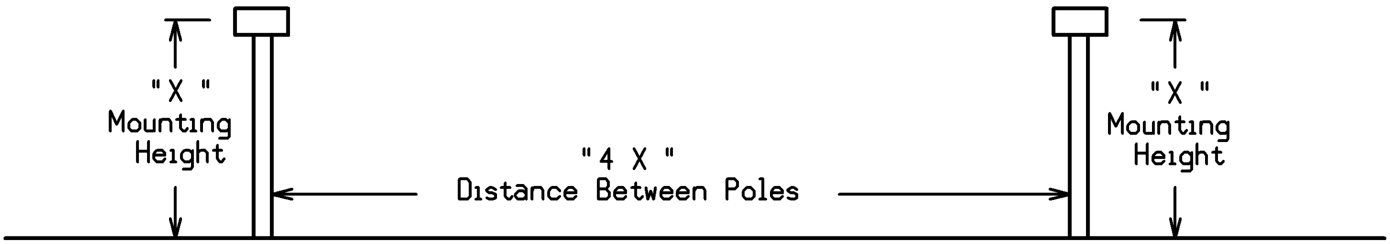


Figure 9
Floodlight Pole Spacing

19.4.70 Light Pollution

Use care in the aiming of floodlights. Never allow a floodlight's light output to extend onto an adjacent roadway into the face of oncoming traffic. Never install a floodlight across a roadway from the intended illumination area. Always be sensitive to the spilling of unwanted light onto adjacent properties. For tighter control of the light output, consider installing a floodlight visor

19.5 ROADWAY LUMINAIRES

This Section provides general requirements for all luminaires used throughout the Company service territory.

High pressure sodium vapor luminaires that are removed from service in good working order shall be returned to Stores for re-use, or disposed of for scrap metal value if found to be damaged. All mercury vapor luminaires shall be disposed of for scrap metal value. Salvage parts such as refractors or door assemblies as necessary for use in maintaining other luminaires.

LED luminaires will not be maintained as they do not have replaceable parts. LED luminaires that fail will simply be replaced with a new luminaire. LED luminaires that fail before the 10 year warrantee period expires are subject for a refund.

All horizontal roadway and floodlight luminaires have the date of manufacture identified inside the luminaire. Luminaires that fail within five years of the date of manufacture should be returned to Stores for possible warranty credit.

19.5.10 Utility Grade

All luminaires shall be designed for long term reliable use in street and area lighting applications. Replacement parts are stocked for all HID luminaires including starters, ballasts and lamps. LED luminaires have no replaceable parts.

19.5.20 Voltage Rating

The standard Company luminaire is designed to operate from a 120 VAC, 2 wire source. Luminaires with other voltage ratings are available as non-standard luminaires to meet specific application needs.

19.5.30 Ballast Selection

All Company luminaires using high intensity discharge lamp sources require an internally mounted ballast transformer. LED's do not require ballasts. Two types of ballast transformers are available for use.

Table 7
Ballast Selection

Ballast Type	Ballast Features
Reactor Ballast	● Single coil ballast wired in series with the lamp. ● Non-regulating – normal power factor ballast. ● Lowest ballast losses = least wasted energy. ● Tolerates line voltage variations to within + or – 5%. ● Standard ballast used in HPS luminaires below 250 Watts. ● Most economical purchase cost.
Regulated (CWA) Ballast	● Two coil ballast. – Constant Wattage Autotransformer ● Regulating – high power factor ballast ● Higher ballast losses than reactor ballast. ● Tolerates line voltage variations to within + or – 10%. ● Standard ballast used in HPS luminaires 250 Watts & above. ● Standard ballast used in all mercury vapor and metal halide luminaires. ● Higher purchase cost than reactor ballast.

Note: The lamp wattage and light source of any HID lamp must match the lamp wattage and light source rating of the HID luminaire it is to be used in. Lamps and luminaires with different wattage ratings or different light sources are not interchangeable.

19.5.40 Starting Aids

All high pressure sodium vapor luminaires require a separate starter to ignite the lamp. The Company Standard is to require a field replaceable plug-in starting aid whenever possible.

19.5.50 Terminal Block

Whenever possible, all Company luminaires shall have a terminal connection block for attachment of the source wiring.

Standard 2 wire, 120 Volt luminaires shall have a three terminal block with the middle terminal connected to the luminaire metal housing with a green housing ground wire.

Non-standard voltage luminaires shall have a two terminal connection block or three terminal connection block as needed.

19.5.60 Luminaire Electrical Load Data

Table 8
HID Luminaire Data

Luminaire Description			Luminaire Component Loads				
Wattage & Light Source	**Ballast Type**	**Source Voltage**	**Rated Lamp Wattage**	**Ballast Wattage**	**Photo Control Wattage**	**Total Wattage Load**	**Maximum Input * Amperage**
100 Watt – MV *ANSI H-38*	Regulated	120 VAC	100 Watts	29 Watts	1 Watt	130 Watts	1.1 A
175 Watt – MV *ANSI H-39*	Regulated	120 VAC	175 Watts	35 Watts	1 Watt	211 Watts	1.7 A
250 Watt – MV *ANSI H-37*	Regulated	120 VAC	250 Watts	56 Watts	1 Watt	307 Watts	2.8 A
400 Watt – MV *ANSI H-33*	Regulated	120 VAC	400 Watts	76 Watts	1 Watt	477 Watts	4.0 A
1,000 Watt – MV *ANSI H-36*	Regulated	120 VAC	1,000 Watts	94 Watts	1 Watt	1,095 Watts	2.5 A
50 Watt - HPS *ANSI S-68*	Reactor	120 VAC	50 Watts	10 Watts	1 Watt	61 Watts	1.5 A
70 Watt - HPS *ANSI S-62*	Reactor	120 VAC	70 Watts	15 Watts	1 Watt	86 Watts	2.0 A
70 Watt - HPS *ANSI S-62*	Regulated	120 VAC	70 Watts	19 Watts	1 Watt	90 Watts	0.8 A
100 Watt - HPS *ANSI S-54*	Reactor	120 VAC	100 Watts	17 Watts	1 Watt	118 Watts	3.2 A
100 Watt - HPS *ANSI S-54*	Regulated	120 VAC	100 Watts	23 Watts	1 Watt	124 Watts	1.2 A
150 Watt - HPS *ANSI S-55*	Reactor	120 VAC	150 Watts	22 Watts	1 Watt	173 Watts	4.4 A
150 Watt - HPS *ANSI S-55*	Regulated	120 VAC	150 Watts	36 Watts	1 Watt	187 Watts	1.6 A
250 Watt - HPS *ANSI S-50*	Regulated	120 VAC	250 Watts	53 Watts	1 Watt	304 Watts	2.5 A
400 Watt - HPS *ANSI S-51*	Regulated	120 VAC	400 Watts	69 Watts	1 Watt	470 Watts	3.9 A
1,000 Watt - HPS *ANSI S-52*	Regulated	120 VAC	1,000 Watts	105 Watts	1 Watt	1,106 Watts	9.7 A
175 Watt – MH *ANSI M-57*	Regulated	120 VAC	175 Watts	31 Watts	1 Watt	207 Watts	1.8 A
250 Watt – MH *ANSI M-58*	Regulated	120 VAC	250 Watts	44 Watts	1 Watt	295 Watts	2.6 A
400 Watt – MH *ANSI M-59*	Regulated	120 VAC	400 Watts	50 Watts	1 Watt	451 Watts	4.0 A
1,000 Watt – MH *ANSI M-47*	Regulated	120 VAC	1,000 Watts	77 Watts	1 Watt	1,078 Watts	9.0 A
175 Watt – PSMH *ANSI M-152E*	Regulated	120 VAC	175 Watts	23 Watts	1 Watt	199 Watts	1.78 A
250 Watt – PSMH *ANSI M-153E*	Regulated	120 VAC	250 Watts	30 Watts	1 Watt	281 Watts	2.5 A
400 Watt – PSMH *ANSI M-155E*	Regulated	120 VAC	400 Watts	48 Watts	1 Watt	449 Watts	4.0 A

* = Maximum input amperage = Starting amperage. Operating amperage will be lower.

Table 8A OH LED Luminaire Data				
Standard ID	**Description**	**Source Voltage***	**Lumens**	**Wattage**
SK06A1	"Local" Roadway Luminaire	120 - 277 VAC	≤ 2000	20
SK06A	"Local" Roadway Luminaire	120 - 277 VAC	2,001 - 4,000	25
SK06C	“Collector” Roadway Luminaire	120 - 277 VAC	4,001 – 8,000	48
SK06G	“Major” Roadway Luminaire	120 - 277 VAC	8,000 – 14,000	96
SK06H	“Expressway” Roadway Luminaire	120 - 277 VAC	20,000 – 30,000	210
SJ06A	"Standard Area" Floodlight	120 - 277 VAC	17,500 – 22,500	150
SJ06B	"Large Area" Floodlight	120 - 277 VAC	37,500 – 42,500	275

Table 8B
HID to LED Roadway Equivalent Conversion Table
(Note: LED luminaires shall only be installed in cities/towns with established rate agreements. Contact Outdoor Lighting if uncertain.)

HID Luminaire					LED Equivalent		
Standard Item	SAP Item ID	Type	Description	Line Voltage	Standard Item	SAP Item ID	Description
SK03A	9309606	HPS	50 Watt	120 VAC	SK06A1 SK06A	9390299	LED, Horizontal Roadway, 20 watts ±, ≤ 2000 delivered lumens, 120-277 VAC, IES
SK03A1	9309717	HPS	50 Watt				
SK03B	9314688	HPS	70 Watt			9389768	LED, Horizontal Roadway, 25 watts ±, 2,001 – 4,000 delivered lumens ±, 120-277 VAC, IES full cutoff, type II.
SK03B1	9315139	HPS	70 Watt				
SK03B2	9300855	HPS	70 Watt				
SK03C	9314705	HPS	100 Watt	120 VAC	SK06C	9389795	LED, Horizontal Roadway, 48 watts ±, 4,001 – 8,000 delivered lumens ±, 120-277 VAC, IES full cutoff, type II.
SK03C1	9314656	HPS	100 Watt				
SK03C2	9311847	HPS	100 Watt				
SK03D	9314704	HPS	150 Watt				
SK03D1	9314687	HPS	150 Watt				
SK03D2	9312004	HPS	150 Watt				
SK03G	9314703	HPS	250 Watt	120 VAC	SK06G	9389786	LED, 96 watts ±, 8,000 – 14,000 Delivered Lumens ±, 120-277 VAC, IES full cutoff, type III.
SK03G1	9314706	HPS	250 Watt				
SK03H	9313589	HPS	400 Watt	120 VAC	SK06H	9389785	LED, 210 watts ±, 20,000 – 30,000 Delivered Lumens ±, 120-277 VAC, IES full cutoff, type III.
SK03H1	9314700	HPS	400 Watt				
SK03K	9314701	HPS	1,000 Watt				
SK05H	9306796	PSMH	400 Watt	120 VAC	SK06H	9389785	LED, 210 watts ±, 20,000 – 30,000 Delivered Lumens ±, 120-277 VAC, IES full cutoff, type III.
SK20C	9317388	HPS	100 Watt	277 VAC	SK06C	9389795	LED, Horizontal Roadway, 48 watts ±, 4,001 – 8,000 delivered lumens ±, 120-277 VAC, IES full cutoff, type II.
SK20D	9317387	HPS	150 Watt				
SK20G	9317386	HPS	250 Watt	277 VAC	SK06G	9389786	LED, 96 watts ±, 8,000 – 14,000 Delivered Lumens ±, 120-277 VAC, IES full cutoff, type III.
SK20H	9309716	HPS	400 Watt	277 VAC	SK06H	9389785	LED, 210 watts ±, 20,000 – 30,000 Delivered Lumens ±, 120-277 VAC, IES full cutoff, type III.

Table 8C
HID to LED Floodlight Equivalent Conversion Table
(Note: LED luminaires shall only be installed in cities/towns with established rate agreements. Contact Outdoor Lighting if uncertain.)

HID Luminaire					LED Equivalent		
Standard Item	SAP Item ID	Type	Description	Line Voltage	Standard Item	SAP Item ID	Description
SJ03B	9314705	HPS	70 Watt	120 VAC	SJ06A	9390958	LED, "Standard Area" Floodlight, 150 watts ±, 17,500 – 22,500 delivered lumens ±, 120-277 VAC, IES NEMA 6x6 or 7x6.
SJ03D	9305870	HPS	150 Watt	120 VAC			
SJ03G	9314672	HPS	250 Watt	120 VAC			
SJ03H	9314671	HPS	400 Watt	120 VAC	SJ06B	9390956	LED, "Large Area" Floodlight, 275 watts ±, 37,500 – 42,500 delivered lumens ±, 120-277 VAC, IES NEMA 6x6 or 7x6.
SJ03H1	9306198	HPS	400 Watt	277 VAC			
SJ03K	9314670	HPS	1,000 Watt	120 VAC			
SJ05H	9306795	PSMH	400 Watt	120 VAC			
SJ04K	9314669	PSMH	1,000 Watt	120 VAC			

19.5.70 LUMINAIRE HID LAMP IDENTIFICATION

This section covers the labeling systems used on all mercury vapor, high pressure sodium vapor, metal halide and LED luminaires for field identification of the lamp wattage, light source and LED type.

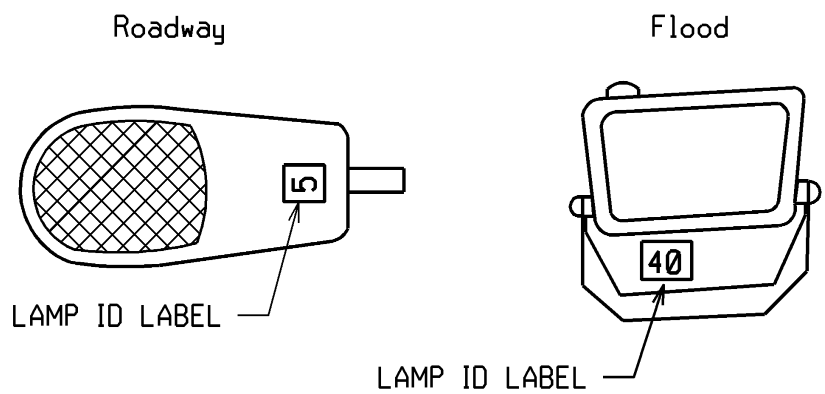


Figure 10
Typical Label Placement on Common Luminaires

Lamp Identification (HID)

A number / color code label system is used to identify the wattage and light source of all HID luminaires. All roadway and floodlight HID luminaires use a 3 inch square label. All post top HID luminaires use a 1 inch square label. New HID luminaires come with factory installed labels. Replacement labels are available from Stores for maintenance.

Table 9
Wattage Code Numbers

Wattage	Wattage Code Number
50	“5”
70	“7”
100	“10”
150	“15”
175	“17”
250	“25”
400	“40”
1,000	“X1”

Table 10
Light Source Color Code

Light Source	Label Background Color
Mercury Vapor	Blue
High Pressure Sodium Vapor	Yellow
Metal Halide – Probe Start	Red
Metal Halide – Pulse Start	Red / White

19.5.80 LED Roadway Luminaire Identification

Two external labels shall be affixed to the underside of the LED roadway luminaire. The first label shall be a 3-inch by 3-inch, black letter on white background wattage label in accordance with ANSI C136.15, latest issue. The second external identification label is for the purpose of PPL to associate the installed luminaire with its internal Item ID number. The font shall be 1-1/4-inch in height. (See Table 11 for label code).

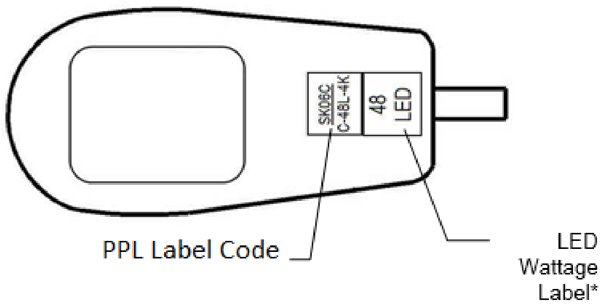
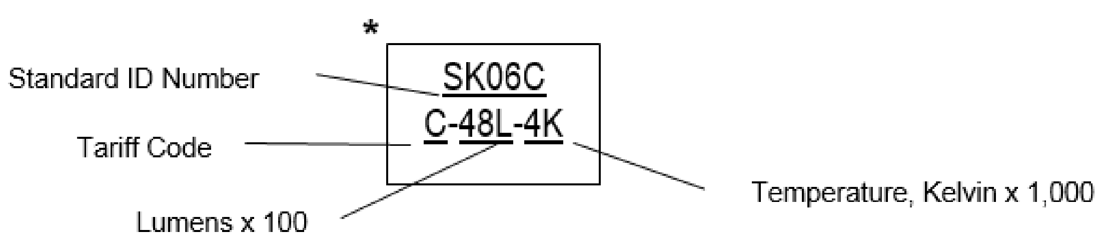


Table 11
LED Roadway Luminaire Label Codes

Standard ID Number	Description	Item ID Number	Lumens	Wattage	Label Code*
SK06A1	"Local" Roadway Luminaire	9390299	1 - 2,000	20	SK06A1 A-20L-4K
SK06A	"Local" Roadway Luminaire	9389768	2,001 – 4,000	25	SK06A B-26L-4K
SK06C	“Collector” Roadway Luminaire	9389795	4,001 – 8,000	48	SK06C C-48L-4K
SK06G	“Major” Roadway Luminaire	9389786	8,000 – 14,000	96	SK06G D-116L-4K
SK06H	“Expressway” Roadway Luminaire	9389785	20,000 – 30,000	210	SK06H F-250L-4K



19.6 BRACKETS

Table 12 identifies the horizontal roadway luminaire loading allowed on standard wood pole street lighting brackets.

Table 12

STD. Item	Bracket	Use For:
SB04	4' Upsweep	50 W – 400 W HID and all LED roadway luminaires
SB06	6' Upsweep	50 W – 250 W HID and all LED roadway luminaires
SB06A	6' Tapered Elliptical	400 W & 1,000 W HID and all LED roadway luminaires
SB08	8' Upsweep with Underbrace	50 W – 250 W HID and all LED roadway luminaires
SB08A	8' Tapered Elliptical	400 W & 1,000 W HID and all LED roadway luminaires
SB10	10' Tapered Truss	50 W – 400 W HID and all LED roadway luminaires
SB12	12' Tapered Truss	50 W – 400 W HID and all LED roadway luminaires
SB16	16' Tapered Truss	50 W – 400 W HID and all LED roadway luminaires
SB20	20' Tapered Truss	50 W – 400 W HID and all LED roadway luminaires

All brackets removed from service shall be inspected and returned to Stores for reuse, or disposed of for scrap metal value if found to be an obsolete design or damaged. All 1-1/4 inch aluminum brackets and all steel brackets shall be disposed of for scrap metal value

19.7 OUTDOOR LIGHTING FIXTURE CONDUCTORS

All street and floodlight luminaire installations shall use 2-1/C #10 AWG copper conductors – BLACK-WHITE twisted pair (STD Item SY4A2) to connect the luminaire to the secondary supply.

Prior to the adoption of the standard SY4 street lighting conductors, many luminaire installations were wired with #12 AWG conductors with THHN insulation.

With the exception of lamp and photocontrol maintenance, whenever the need arises to work on a luminaire wired with the older #12-THHN or #10-XHHW conductors, or when the existing conductor insulation is found to be cracked or deteriorated, the luminaire shall be completely rewired using STD Item SY4 conductors.

When the need arises to extend the length of existing luminaire conductors, the luminaire shall be completely rewired using STD Item SY4 conductors.

In no cases shall luminaire conductors be spliced be any method to create the desired length.

19.8 CUSTOMER OWNED STREET LIGHTING EQUIPMENT INSTALLED ON COMPANY OWNED DISTRIBUTION POLES

This document contains information that is provided for reference purposes only, and should not be construed or used as a substitute for an analysis of the applicable tariffs, agreements, and safety regulations specific to each particular customer.

19.8.10 Safety

The number 1 priority of every job is:

SAFETY!

PPL's distribution poles carry electric lines that operate at voltages as high as 34,500 volts and can carry very high amperages.

PPL's underground infrastructure carries the same very high distribution voltages and amperages in a confined space and may also carry sub-transmission or transmission lines that operate at even higher voltage levels.

Outdoor street and area lights are installed within the electric space on a distribution pole. Performing work on outdoor lights may require the worker to be in close proximity to the distribution lines.

It is the responsibility of the customer that owns, operates and maintains outdoor lighting to ensure that all personnel working on the outdoor lighting system are qualified to work in the designated electric supply space of the Company's electric distribution system in accordance with OSHA 1910.269. An executed copy of the Company's ACKNOWLEDGEMENT FOR THE USE OF QUALIFIED ELECTRICAL WORKERS form is mandatory.

OVERHEAD DISTRIBUTION
No customer, customer's employees, or contractors are ever allowed to perform any work on PPL's 120/240 volt or 120/208 volt secondary conductors.

UNDERGROUND DISTRIBUTION
No customer, customer's employees, or contractors are ever allowed to enter a PPL manhole, handhole or other structure for any reason without PPL safety supervision personnel being present on site.

IF UNSURE: - **STOP** – Call PPL for assistance.

No outdoor lighting repair is too important to sacrifice personal safety.

19.8.20 **<u>GENERAL</u>:** These Standards identify requirements to enable a customer to safely install, remove, and maintain a customer owned outdoor lighting system which is installed on PPL distribution poles and/or connected to PPL overhead or underground secondary conductors.

All customer owned outdoor lighting shall be in compliance with the applicable provisions of the National Electric Safety Code, (NESC) latest edition, and the applicable PPL Construction Standards.

The customer shall be responsible to own, operate, and maintain all outdoor lighting equipment beyond the service tap connections to PPL. This shall include, but not be limited, to the following:

1. Supplying all material and labor.
2. Transferring an overhead supplied outdoor light attachment to a new pole in the event of a pole replacement.
3. Relocating an overhead supplied outdoor light attachment to accommodate other construction activities on the pole.
4. Performing any work required on the outdoor lighting underground conduit system, conductors, foundation, pole, arm and luminaire.
5. Emergency 24 hour response to remove or make safe:
   (a) the outdoor light attachment in the event of a damaged/broken pole.
   (b) the underground sourced outdoor light in the event of a damaged/structurally failed lighting standard or supporting structure.

<u>NOTE</u>: In an emergency, (i.e. 911 notification response, weather related storm or natural disaster restoration, etc.) PPL personnel may perform, at customer expense, any customer outdoor lighting work PPL deems necessary to maintain public or employee safety.

19.8.30 <u>Electrical Separation</u>: The customer is responsible to create an electrical separation between the PPL secondary conductors and the customer owned outdoor lighting conductors. This is required to insure the safety of PPL and customer employees. This is accomplished by installing, at a minimum, a dual pole in-line fuse holder with a midget cartridge style fuse on every outdoor light supply located as near as possible to the connection to the PPL owned secondary conductors. This fuse/disconnect device, in addition to providing electrical protection, shall serve as a future disconnect point for the customer owned outdoor light. Once installed, the customer may disconnect or reconnect a customer owned outdoor light only by means of the in-line fuse holder/disconnect device. See Figure 12 for overhead supplied outdoor lights, and Figures 13 or 14 for underground supplied outdoor lights. See Figure 11 for in-line fused disconnect details. The in-line fuse holder/disconnect device does not define where PPL ownership ends, and customer ownership begins. The point of ownership demarcation is at the point of connection to the distribution system. The company owns up to and including the connector.

7/19 – revised emergency response language.

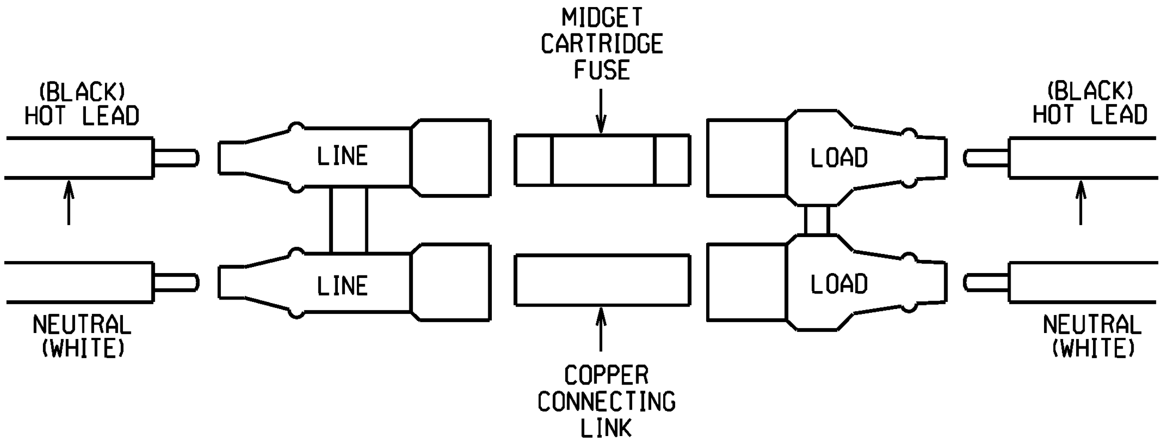


Figure 11– In-Line Fused Disconnect Details

1. All customer owned outdoor lighting equipment shall be fused using a dual pole, watertight, in-line fuse holder and cartridge style fuse. This fuse, in addition to providing electrical protection, shall serve as a disconnection point for the customer owned outdoor lighting equipment.

2. Fuse Holder
   The fuse holder shall be a watertight device suitable for use in an outdoor environment.

   The fuse holder shall be totally insulated, thus having no exposed energized parts.

   The fuse holder shall accept #14 AWG - #6 AWG stranded copper conductors on both ends.

   The fuse holder shall be a dual pole device allowing simultaneous disconnection of both the 120 VAC hot lead (black wire) and the neutral conductor (white wire).

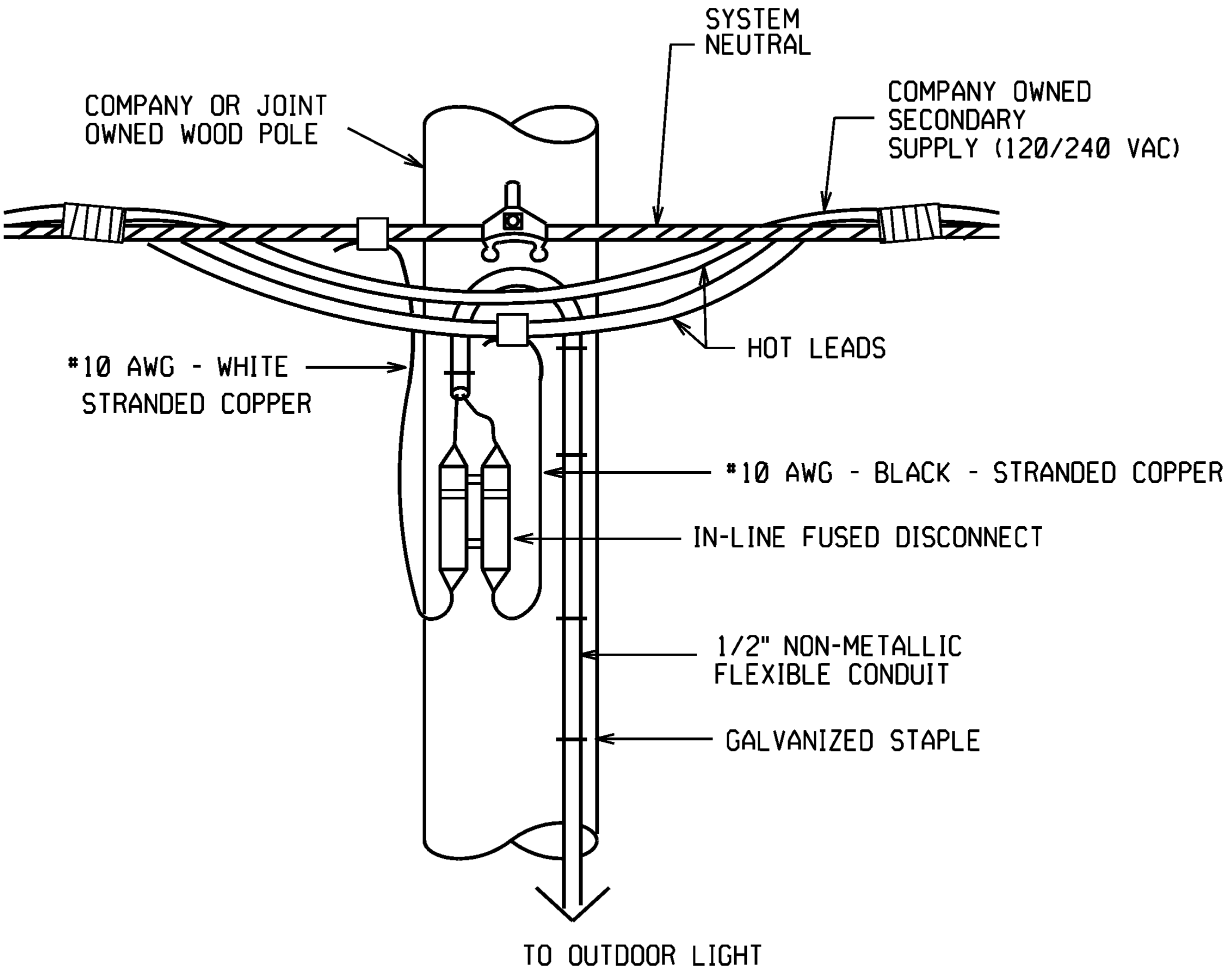
   The fuse holder shall be designed such that, when separated, the midget cartridge fuse and copper connecting link shall be held captive in the load end of the fuse holder.

   The fuse holder shall be polarized to prevent accidental reversal of the live leg and neutral connections.

3. Cartridge Fuse
   The fuse shall be a non-glass type, midget style cartridge fuse. Fuse dimensions shall be 13/32" diameter x 1½" length.

4. Neutral Connection
   The neutral conductor shall not be fused. Install a 13/32" diameter x 1½" length copper connecting link in place of a cartridge fuse.

5. Always provide sufficient slack in wiring to facilitate fuse replacement.



New issue

Figure 12 – Connection of Overhead Supplied Customer Owned Outdoor Light to PPL Overhead Secondary Conductors

1. Every customer outdoor light shall have an in-line fused disconnect as described above in “Electrical Separation”. See Figure 11 for details on the in-line fused disconnect.

2. Secure the in-line fused disconnect to the pole using a spring loaded conduit clip or galvanized staple.

3. Provide sufficient slack in the luminaire wiring to facilitate fuse replacement.

4. Outdoor lighting fixture wiring shall be #10 AWG 7-strand copper BLACK-WHITE with RHH/RHW/USE-2

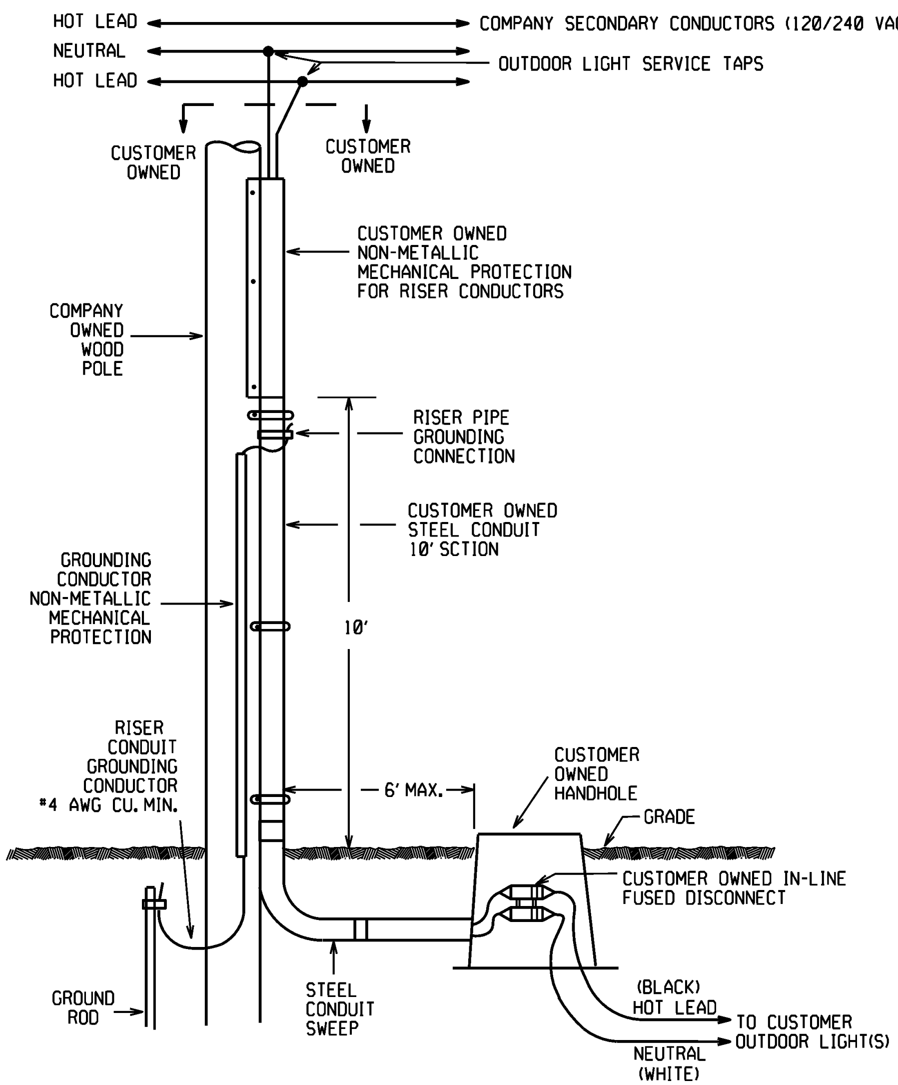


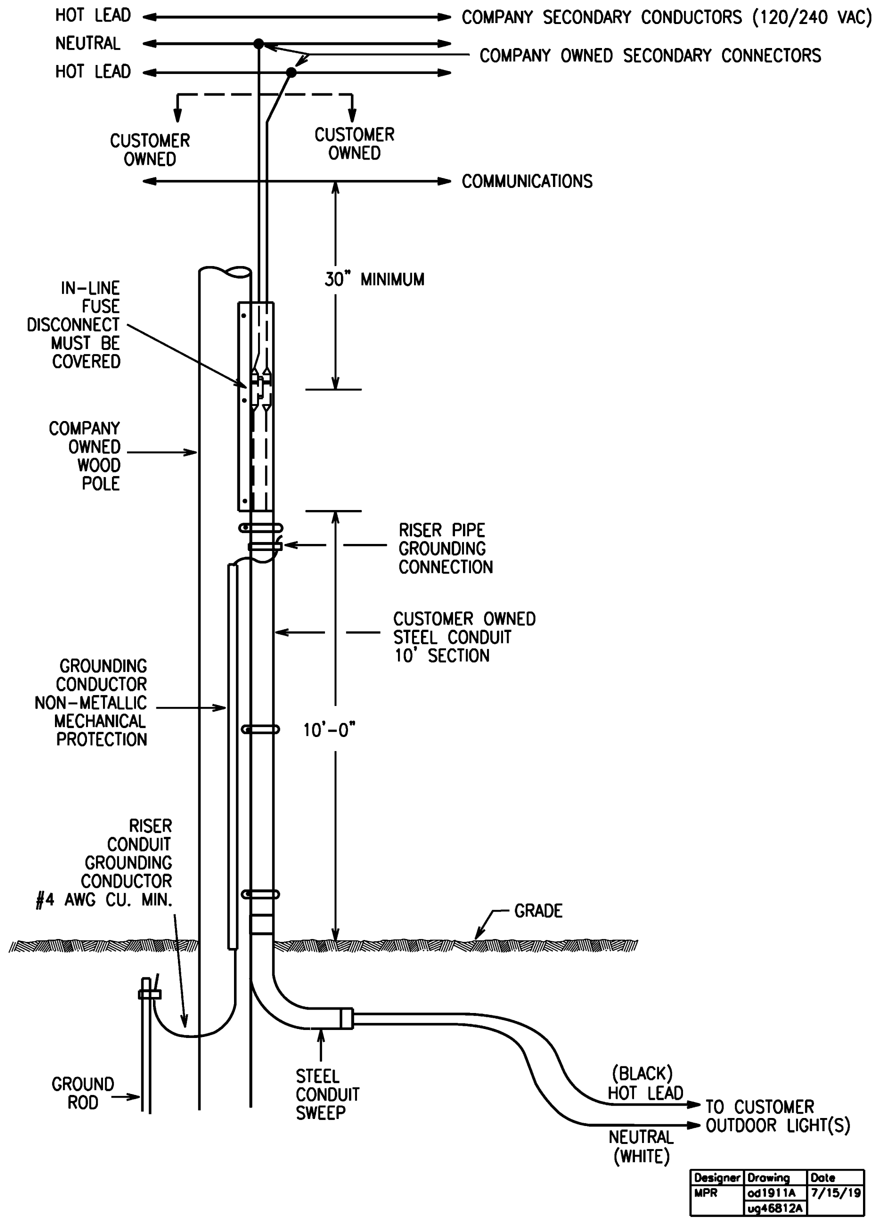
Figure 13 – Connection of Customer Owned Outdoor Lighting Riser to PPL Overhead Secondary Conductors

1. Install customer owned handhole as shown. Customer owned handhole shall house the in-line fused disconnect. See Figure 11 for details on the in-line fused disconnect.

2. Always install the riser conduit away from vehicle traffic.

3. No more than (2) riser conduits may be attached to a pole. Consult PPL Engineering if more than (2) risers are desired.

4. Underground supply conductors shall be #6 AWG 7-strand copper (minimum) with RHH/RHW/USE-2 insulation. Conductors shall be color coded BLACK = Hot lead, WHITE = Neutral.



7/19 - New Drawing.

Figure 14 – Alternate Connection of Customer Owned Outdoor Lighting Riser to PPL Overhead Secondary Conductors

1. Install customer owned disconnects under conductor covering. See Figure 11 for details on the in-line fused disconnect.

2. Always install the riser conduit away from vehicle traffic.

3. No more than (2) riser conduits may be attached to a pole. Consult PPL Engineering if more than (2) risers are desired.

4. Underground supply conductors shall be #6 AWG 7-strand copper (minimum) with RHH/RHW/USE-2 insulation. Conductors shall be color coded BLACK = Hot lead, WHITE = Neutral.

19.8.40 Ownership Identification: The customer is responsible to label all customer owned outdoor lighting luminaires in accordance with PPL Construction Standards. See Figures 15 and 16.

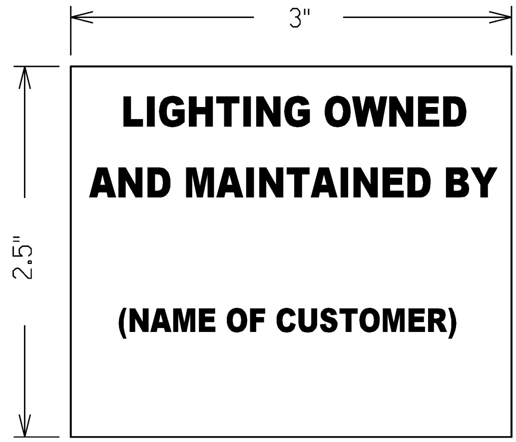


Figure 15 – Ownership Identification Label for Customer Owned Outdoor Luminaires

1. All customer owned outdoor light luminaires shall be identified with a label to clearly define ownership and maintenance responsibilities.

2. Ownership identification labels shall be reflective white with black lettering.

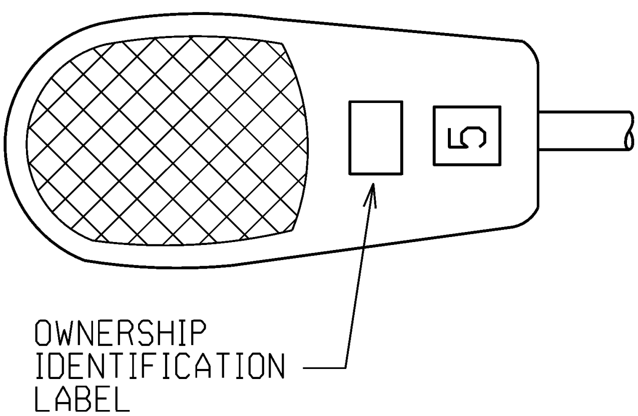
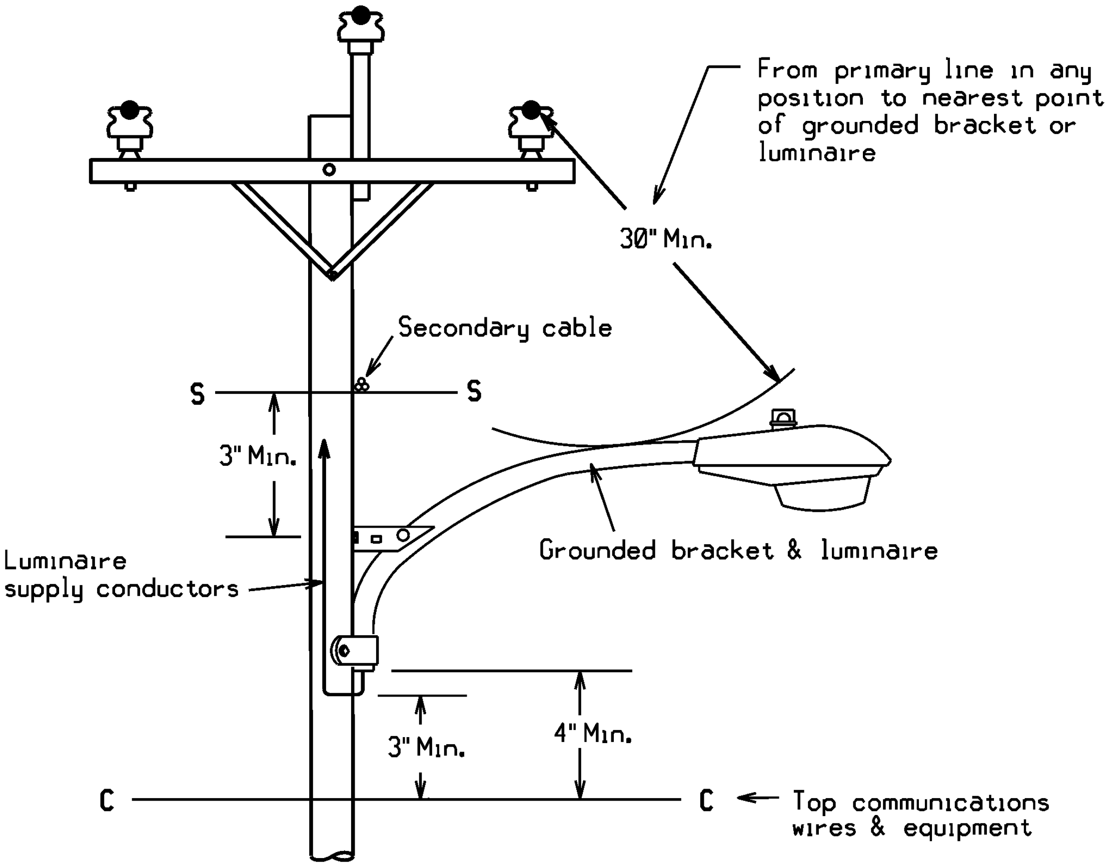


Figure 16– Installation of Ownership Identification Label

1. Ownership identification label shall be installed on the lower door of a horizontal roadway luminaire such that it is clearly visible from the ground.

2. For post top, floodlight, and other luminaires, the ownership identification label shall be installed on the luminaire housing in a location such that it is clearly visible from the ground.

19.8.50 Final Connections to PPL 120/240 VAC or 120/208 VAC Secondary Conductors: PPL personnel and/or their designee shall make all connections and disconnections of customer owned street light supply conductors to the Company owned secondary and grounding conductors. Customer employees or their contractors are never allowed to perform any work on Company owned secondary or grounding conductors.



Clearances from Overhead Conductors

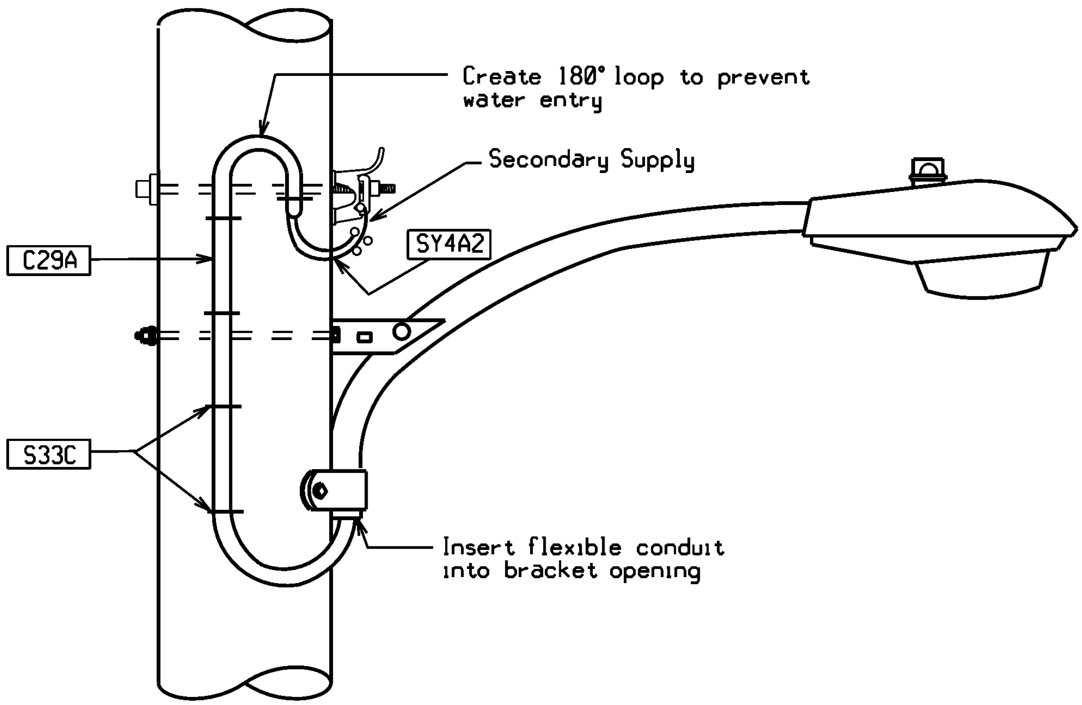
1. Primary Conductors – Maintain minimum 30-inch clearance from any primary conductor or cable to nearest point of grounded luminaire or bracket.

2. Secondary Conductors – Maintain minimum 3-inch vertical clearance from secondary wires or cable to nearest point of grounded luminaire bracket. (NESC Table 239-1)

3. Communications Cables – Maintain minimum 4-inch vertical clearance from closest communication cable to nearest point of grounded luminaire bracket. (NESC Table 238-2)

   Maintain minimum 3-inch clearance from closest communications cable to nearest point of luminaire supply conductors drip loop. Luminaire supply conductors must be covered with non-metallic flexible conduit. (NESC 238D)

4. See Standards Section 17 for additional information on Clearances.



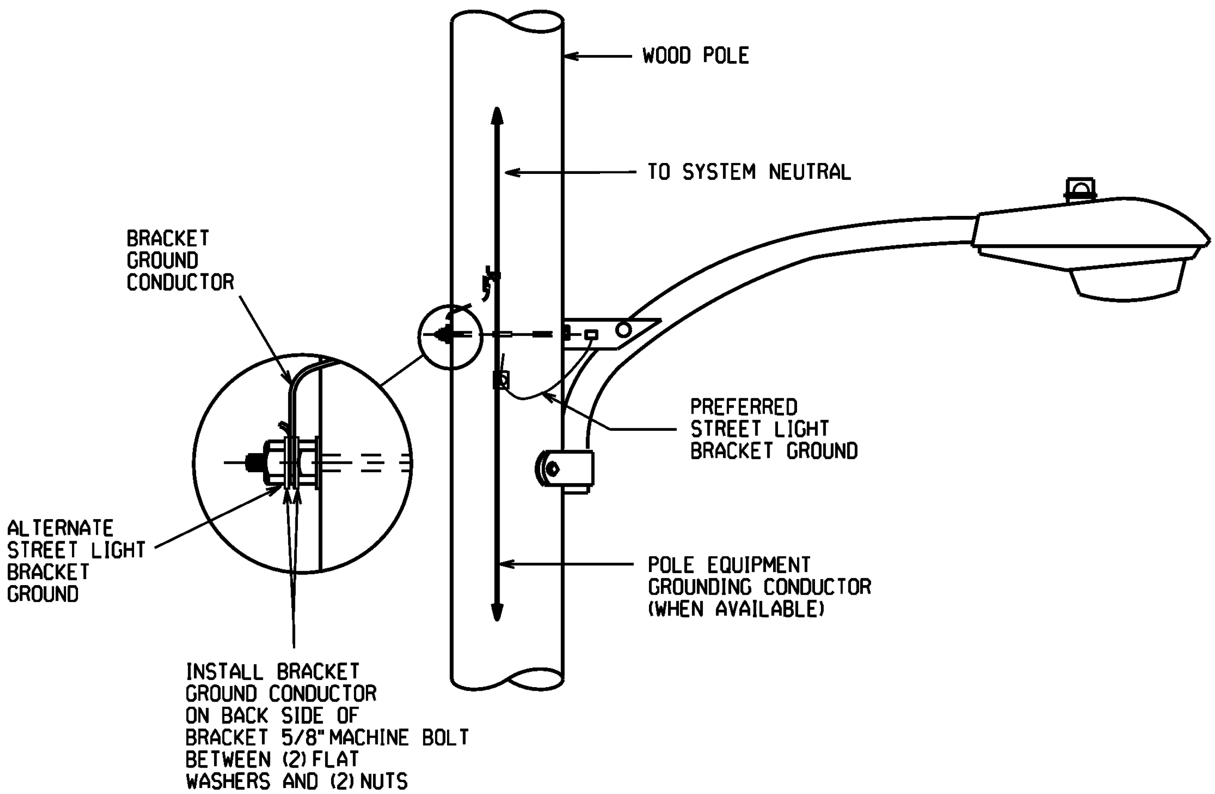
Mechanical Protection of Outdoor Lighting Fixture Conductors

1. NESC Table 239G1 requires that all luminaire supply conductors (#10 AWG) shall have mechanical protection (1/2" non-metallic flexible conduit) installed from the point where they leave the pole end of the bracket to the connection to the secondary supply in order to take advantage of the clearance dimensions shown on Standards page 19-100.

2. Insert the non-metallic flexible conduit into the bracket opening and extend up the pole to above the secondary supply.

3. Create a 180 degree loop at the secondary supply to prevent rain water from becoming trapped inside the flexible conduit.

4. Secure the non-metallic flexible conduit with galvanized staples spaced 12-inches apart or closer as necessary.



New Issue.

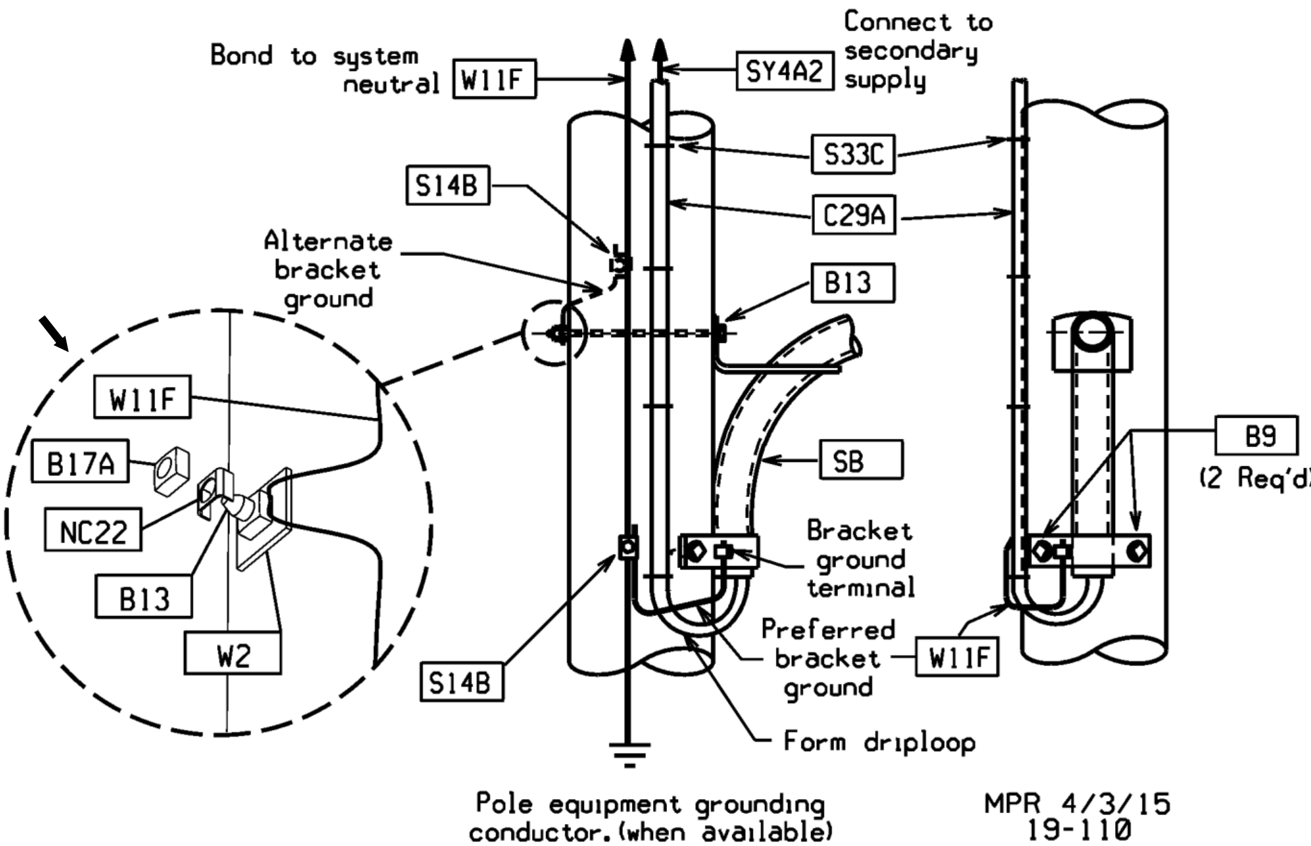
New issue

New issue

Grounding of Overhead Supplied Outdoor Light

1. Every outdoor light bracket shall be grounded. Install a #4 AWG stranded copper conductor with enough length to connect to the pole equipment grounding conductor (when available) or to the secondary system neutral. Final connections to PPL conductors are made by PPL personnel or their designee.

2. Many brackets have a bracket grounding bolt located near the wood pole end of the bracket. If none exists, install a bracket grounding bolt on the bracket or connect grounding conductor to the back side of the 5/8" square head machine bolt which secures the bracket to the pole.



Street Light Installation Using Upsweep or Tapered Elliptical Bracket

Supersedes 7/13 Issue – Added grounding clip.

1. Before installation, always check luminaire nameplate to insure desired wattage and operating voltage.

2. Follow manufacturer's guidelines (supplied with every luminaire) for proper installation. Level luminaire using slipfitter hardware supplied.

3. Adequate clearances from overhead conductors must be maintained. See Standards page 19-100 for details.

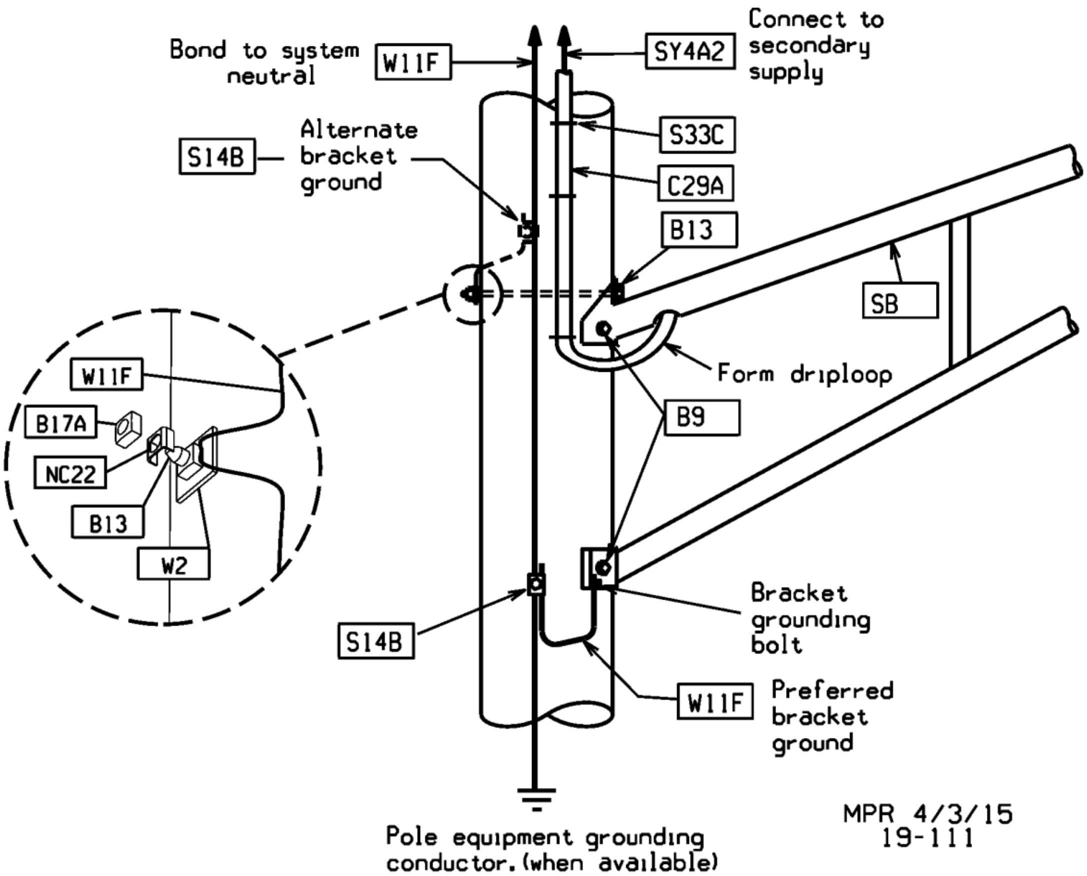
4. Install ½" flexible conduit to protect wiring. See Standards page 19-101 for details.

5. All installations require one 5/8 inch square head machine bolt and two 1/2 inch x 4 inch lag screws. Both required lag screws must be installed in order for bracket to withstand horizontal wind loading forces. Never drive lag screws during bracket/luminaire installation with lamp installed. Lamp life will be reduced. Always install photoelectric control last.

6. Every bracket shall be grounded. Connect #4 AWG copper bracket grounding conductor to the pole equipment grounding conductor when available. Otherwise, connect bracket equipment ground conductor to system neutral.

7. All luminaries come equipped with a factory installed, black plastic, or metal, wildlife guard which is designed to prevent birds from entering the luminaire at the opening where the bracket is inserted. To insure luminaire reliability, make sure this guard remains in place after the luminaire is attached to the bracket.

8. When opening the luminaire's lower door, never allow the door to freely swing open.



Street Light Installation Using Tapered Truss Bracket

1. Before installation, always check luminaire nameplate to insure desired wattage and operating voltage.

2. Follow manufacturer's guidelines (supplied with every luminaire) for proper installation. Level luminaire using slipfitter hardware supplied.

3. Adequate clearances from overhead conductors must be maintained. See Standards page 19-100 for details.

4. Install ½" flexible conduit to protect wiring. See Standards page 19-101 for details.

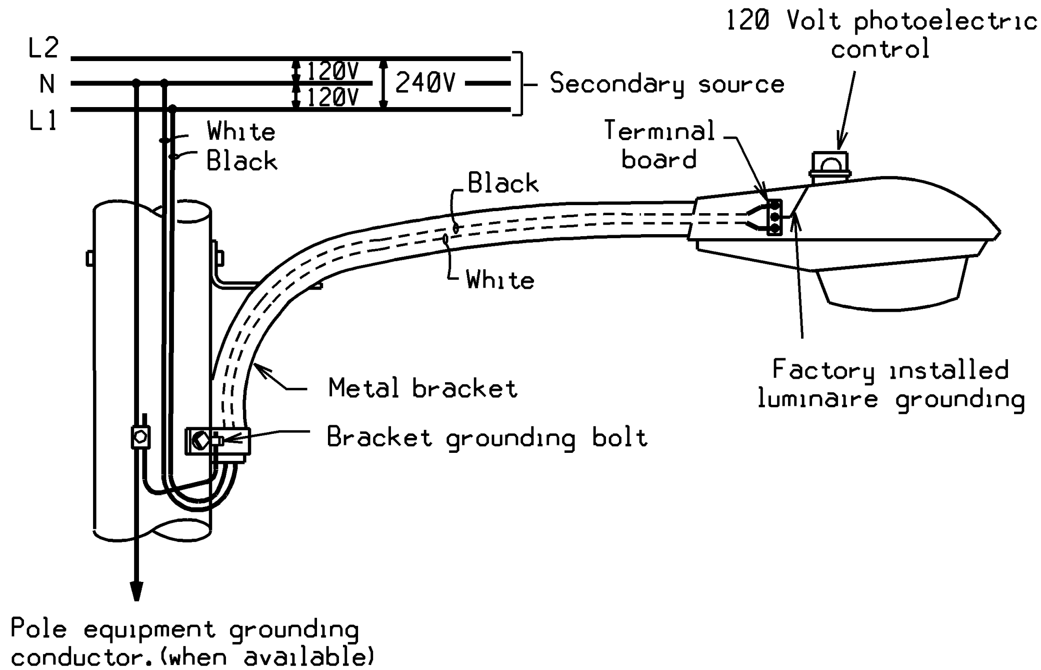
5. All installations require one 5/8 inch square head machine bolt and four 1/2 inch x 4 inch lag screws. All required lag screws must be installed in order for bracket to withstand horizontal wind loading forces. Never drive lag screws during bracket/luminaire installation with lamp installed. Lamp life will be reduced. Always install photoelectric control last.

6. Every bracket shall be grounded. Connect #4 AWG copper bracket grounding conductor to the pole equipment grounding conductor when available. Otherwise, connect bracket equipment ground conductor to system neutral.

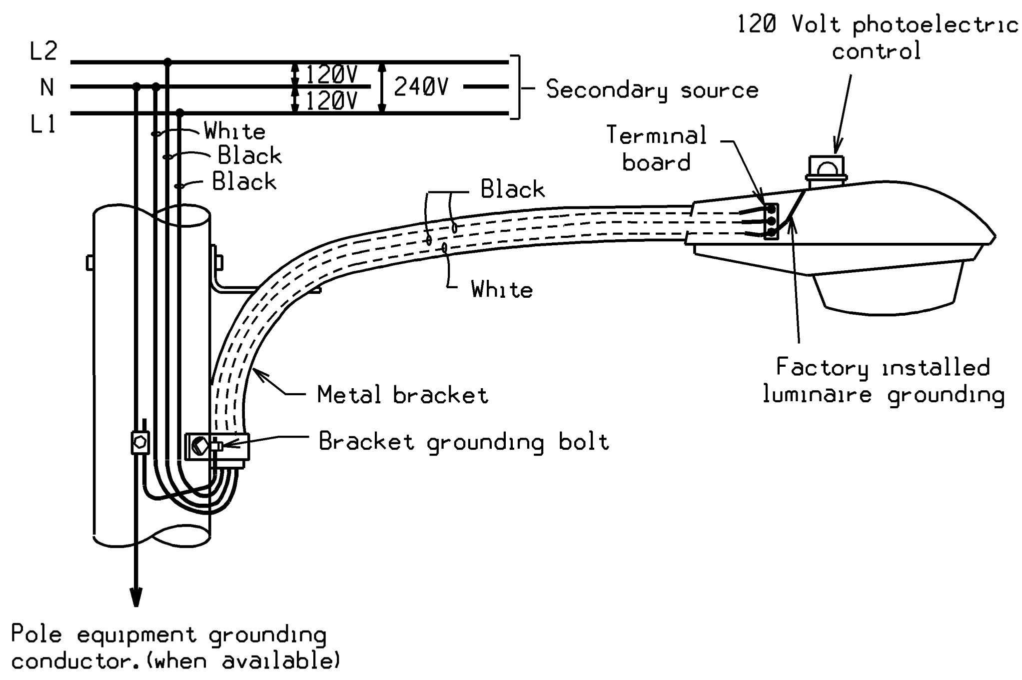
7. All luminaries come equipped with a factory installed, black plastic, or metal, wildlife guard which is designed to prevent birds from entering the luminaire at the opening where the bracket is inserted. To insure luminaire reliability, make sure this guard remains in place after the luminaire is attached to the bracket.

8. When opening the luminaire's lower door, never allow the door to freely swing open.

9. Never install a tapered truss bracket with any conductor located between the upper and lower truss members.



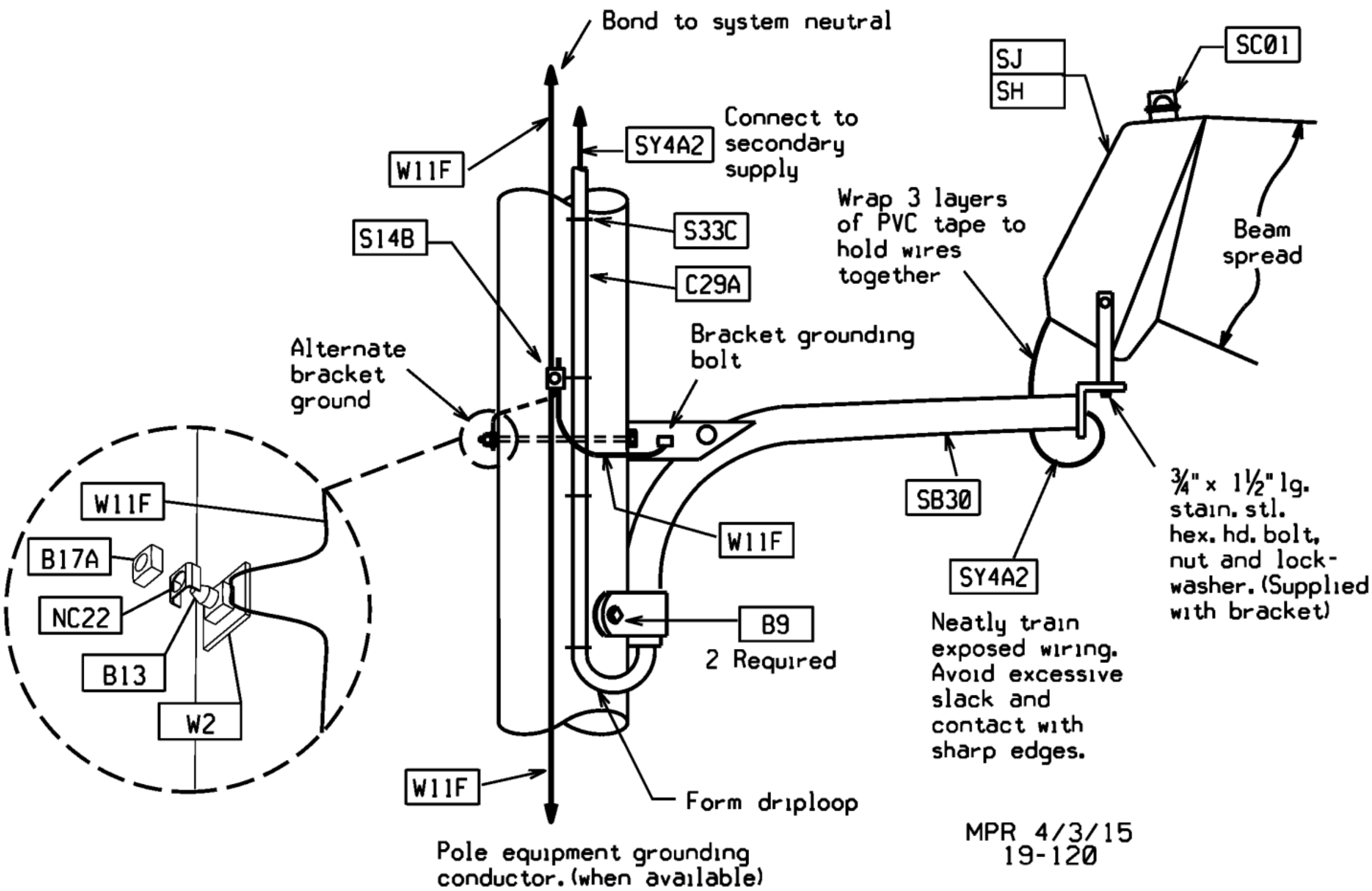
Wiring Diagram for 120 Volt Street Light Luminaire



1. The ballast operates at 240 volts and is connected between "L1" and "L2". The photoelectric control switches the "L1" line only and is factory connected for 120 volt between "L1" and "N".

Wiring Diagram for 120/240 Volt Street Light Luminaire

Supersedes 7/07 Issue – Information formerly on page 19-402.



Single Floodlight Installation on Wood Pole

1. Before installation, always check luminaire nameplate to insure desired wattage and operating voltage.

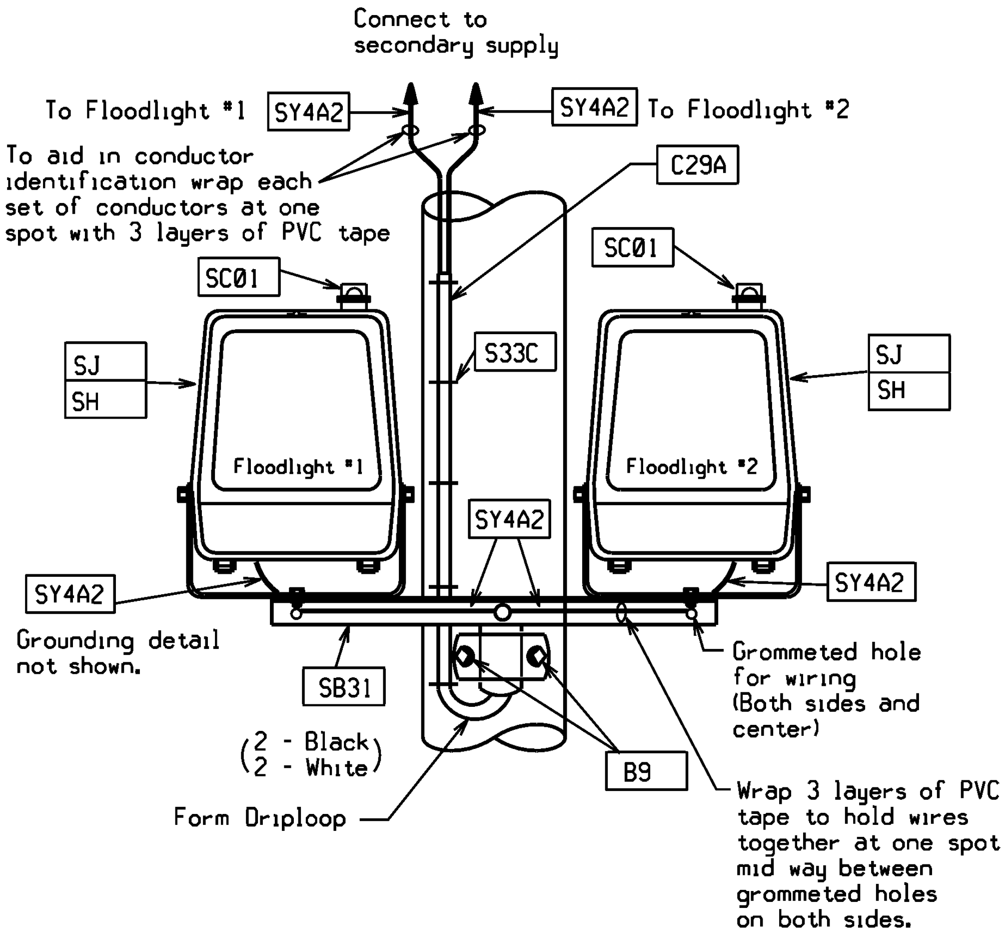
2. Follow manufacturer's guidelines (supplied with every luminaire) for proper installation.

3. Adequate clearances from overhead conductors must be maintained. See Standards page 19-100 for details.

4. Install ½" flexible conduit to protect wiring. See Standards page 19-101 for details.

5. All installations require one 5/8 inch square head machine bolt and two 1/2 inch x 4 inch lag screws. Both required lag screws must be installed in order for bracket to withstand horizontal wind loading forces. Never drive lag screws during bracket/luminaire installation with lamp installed. Lamp life will be reduced. Always install photoelectric control last.

6. Every bracket shall be grounded. Connect #4 AWG copper bracket grounding conductor to the pole equipment grounding conductor when available. Otherwise, connect bracket equipment ground conductor to system neutral.



Twin Flood Light Installation on Wood Pole

1. Before installation, always check luminaire nameplate to insure desired wattage and operating voltage.

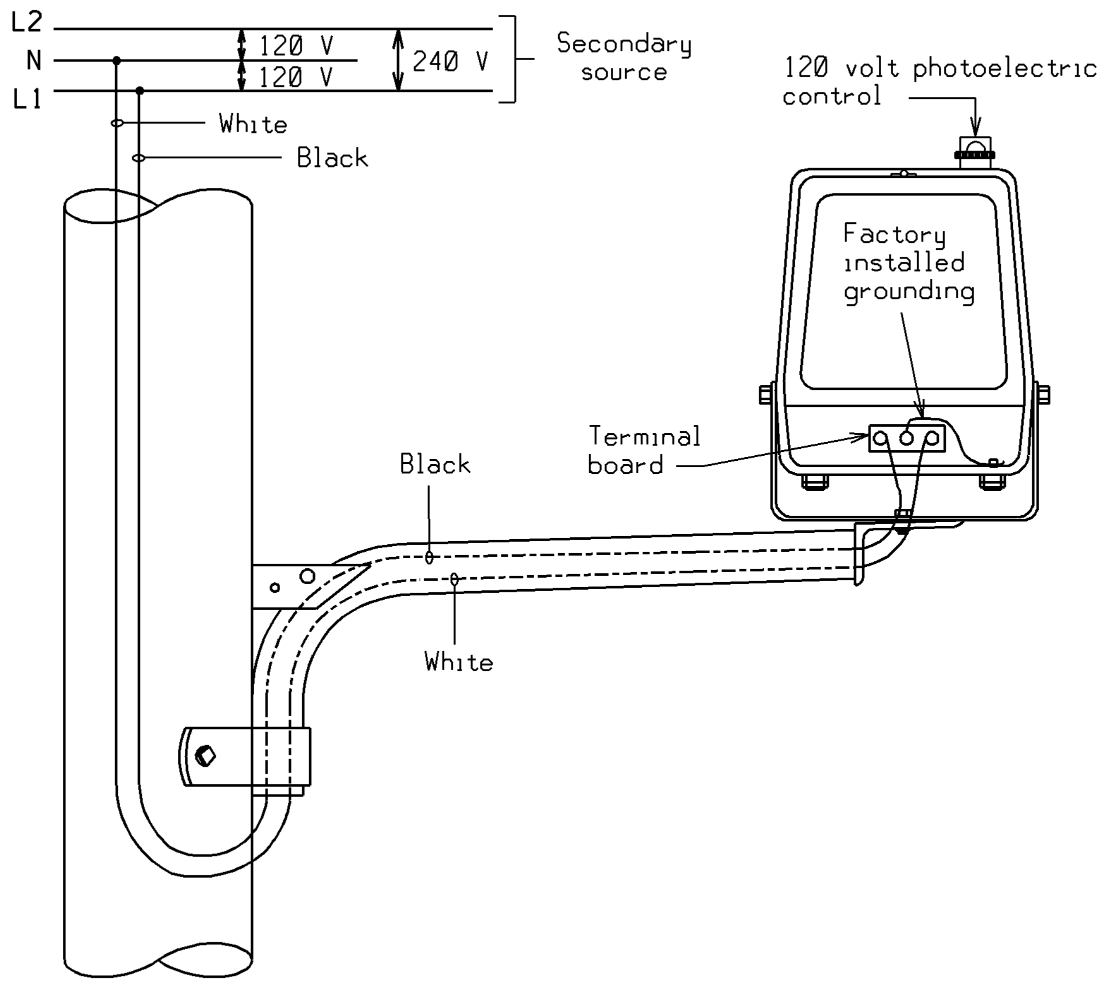
2. Follow manufacturer's guidelines (supplied with every luminaire) for proper installation.

3. Adequate clearances from overhead conductors must be maintained. See Standards page 19-100 for details.

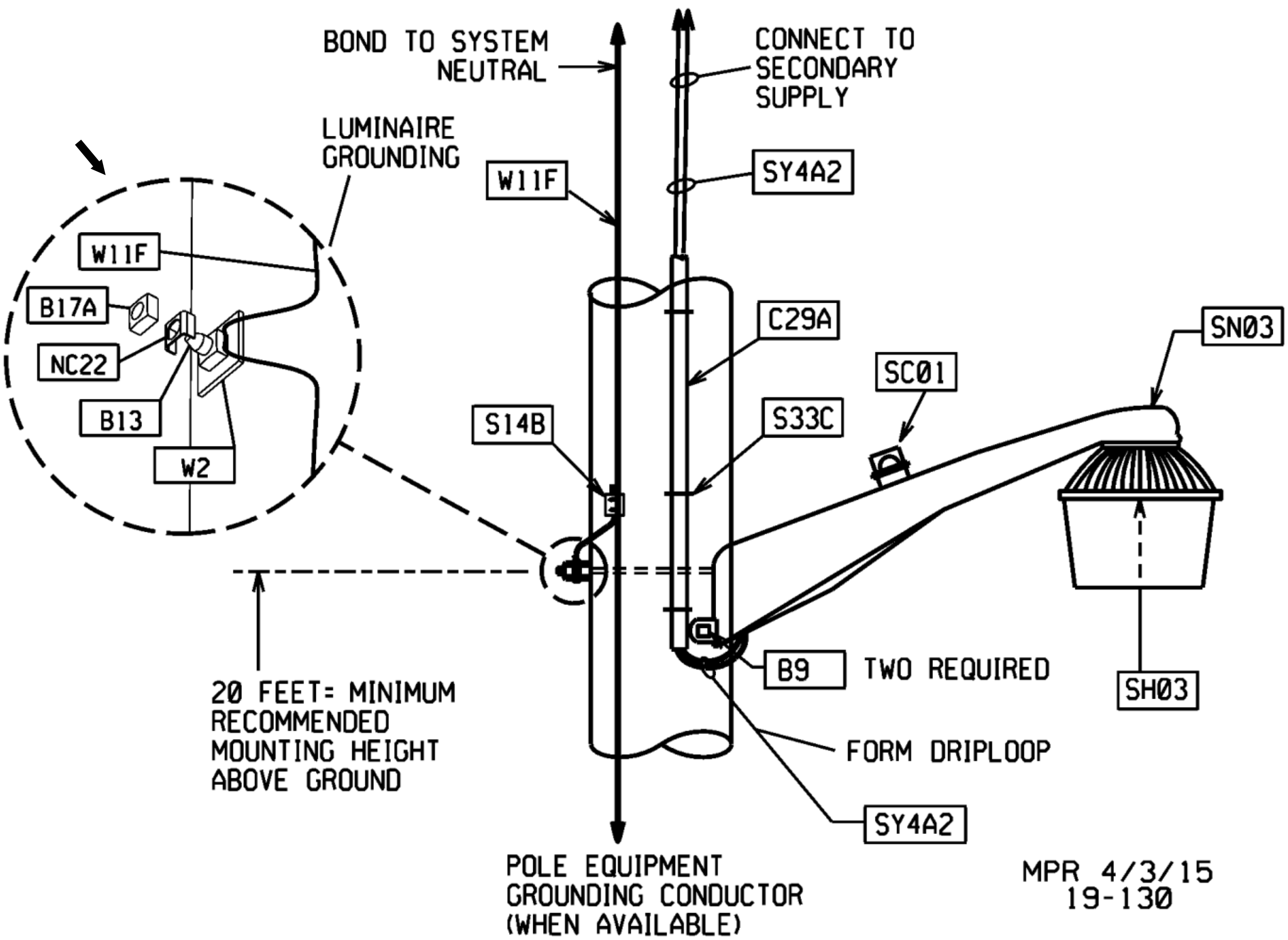
4. Install ½" flexible conduit to protect wiring. See Standards page 19-101 for details.

5. All installations require one 5/8 inch square head machine bolt and two 1/2 inch x 4 inch lag screws. Both required lag screws must be installed in order for bracket to withstand horizontal wind loading forces. Never drive lag screws during bracket/luminaire installation with lamp installed. Lamp life will be reduced. Always install photoelectric control last.

6. Every bracket shall be grounded. Connect #4 AWG copper bracket grounding conductor to the pole equipment grounding conductor when available. Otherwise, connect bracket equipment ground conductor to system neutral



Wiring Diagram for 120 Volt Flood Light Luminaire



Supersedes 7/13 Issue – Added grounding clip.

Residential Security Luminaire Installation on Wood Pole

1. Before installation, always check luminaire nameplate to insure desired wattage and operating voltage.

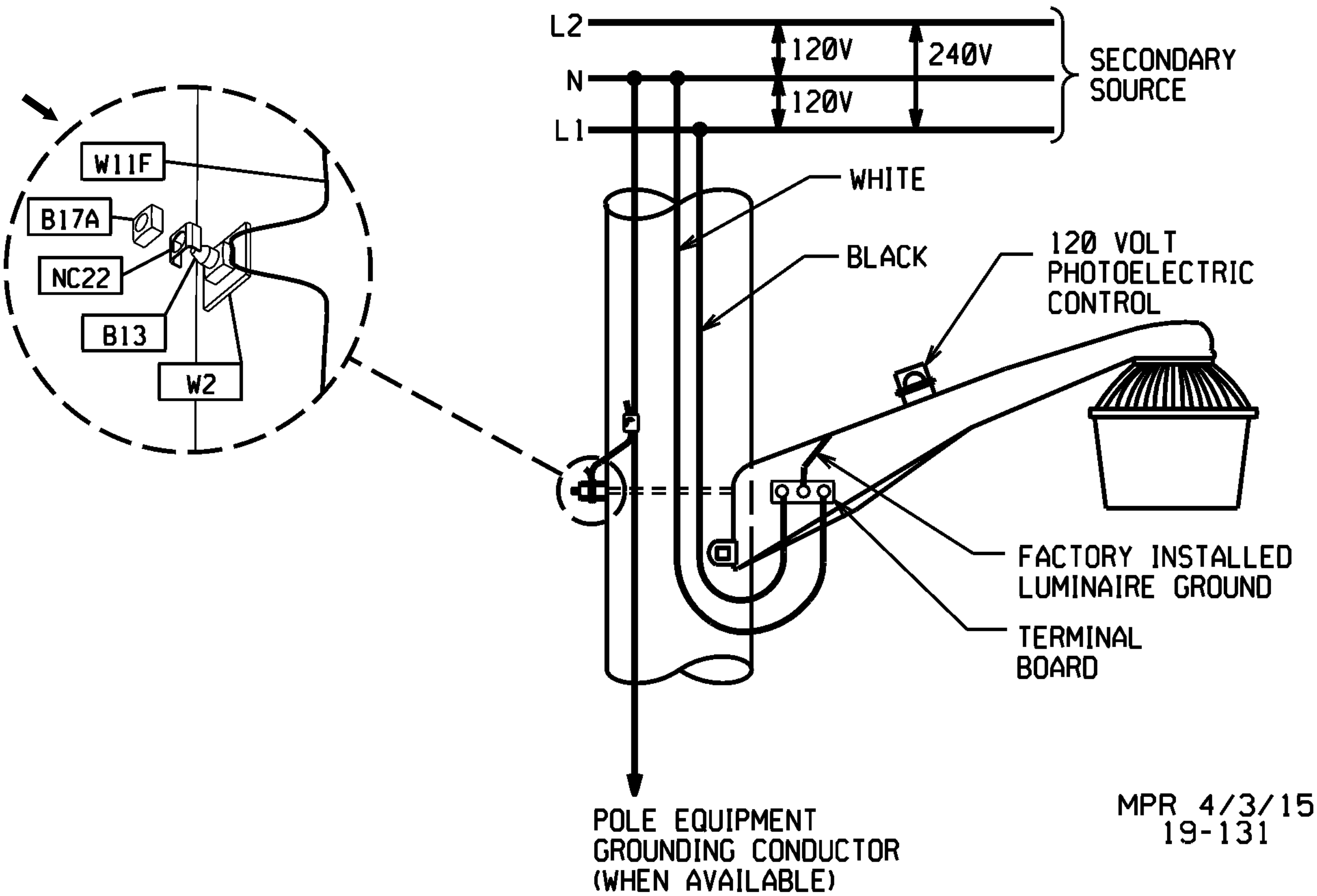
2. Follow manufacturer's guidelines (supplied with every luminaire) for proper installation.

3. Adequate clearances from overhead conductors must be maintained. See Standards page 19-100 for details.

4. Install ½" flexible conduit to protect wiring. See Standards page 19-101 for details.

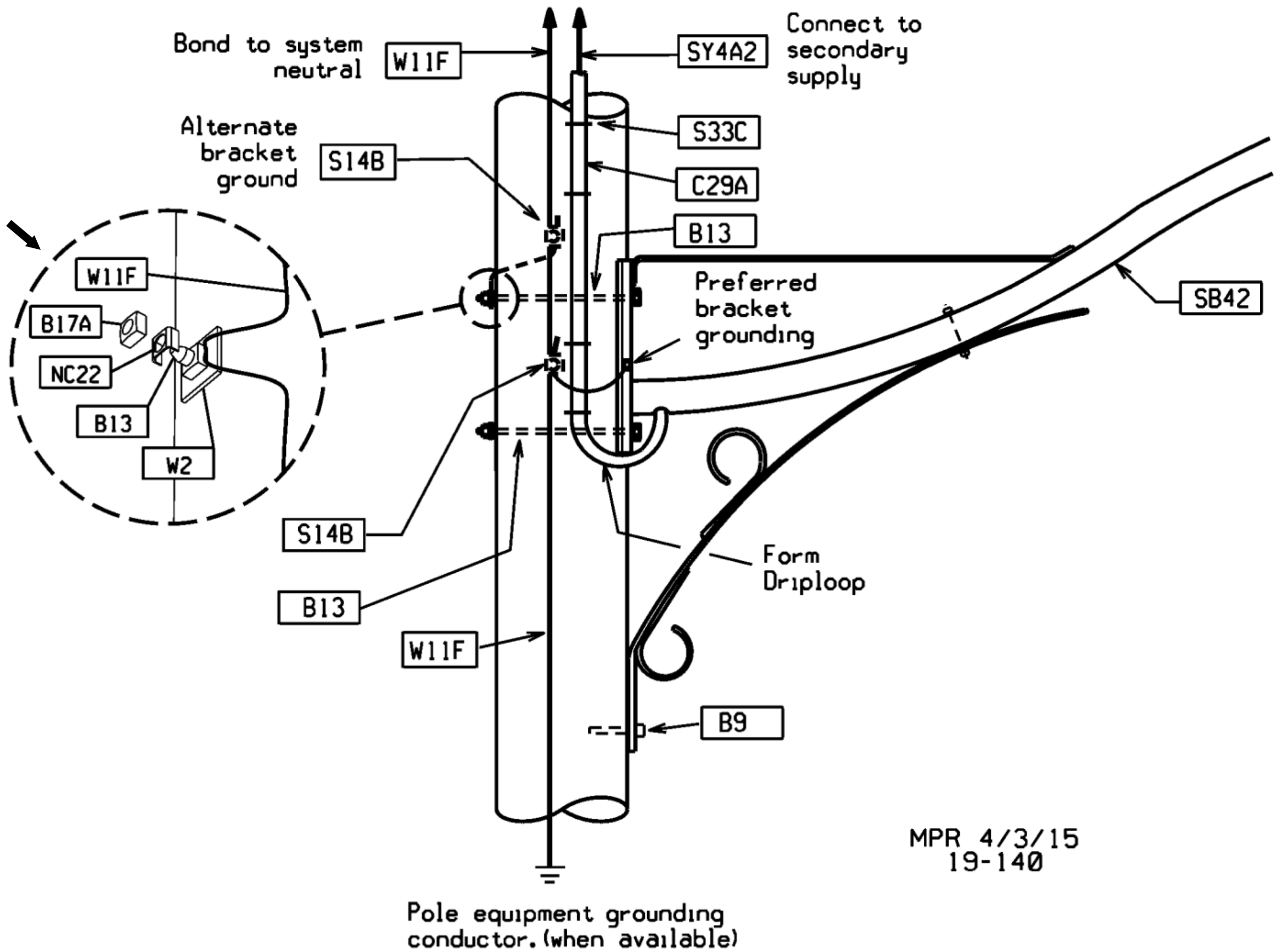
5. All installations require one 5/8 inch square head machine bolt and two 1/2 inch x 4 inch lag screws. Both required lag screws must be installed in order for bracket to withstand horizontal wind loading forces. Never drive lag screws during bracket/luminaire installation with lamp installed. Lamp life will be reduced. Always install photoelectric control last.

6. Every bracket shall be grounded. Connect #4 AWG copper bracket grounding conductor to the pole equipment grounding conductor when available. Otherwise, connect bracket equipment ground conductor to system neutral.



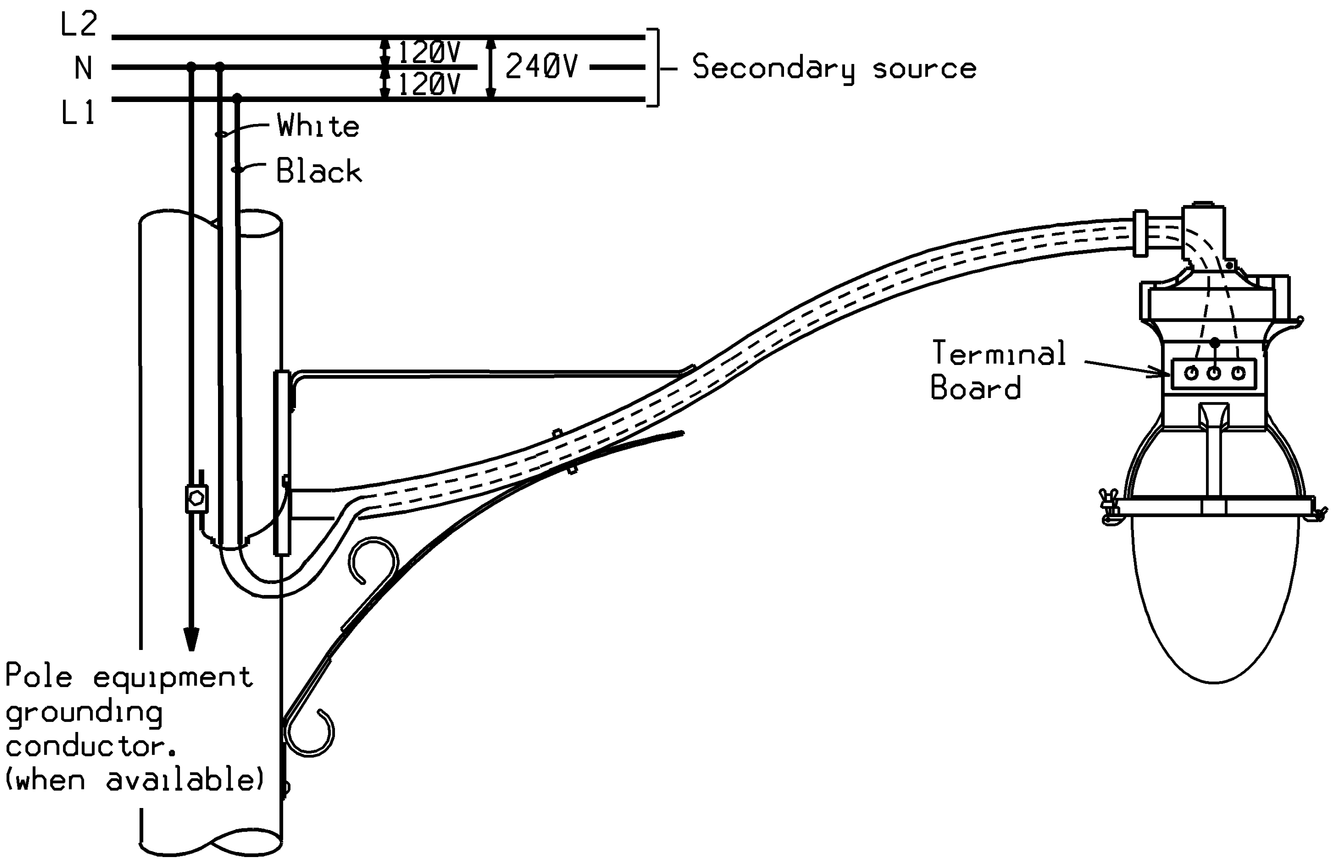
Wiring Diagram for 120 Volt Residential Security Luminaire

Supersedes 7/13 Issue – Added grounding clip.



Teardrop Luminaire Installation on Wood Pole

1. Before installation, always check luminaire nameplate to insure desired wattage and operating voltage.
2. Follow manufacturer's guidelines (supplied with every luminaire) for proper installation.
3. Adequate clearances from overhead conductors must be maintained. See Standards page 19-100 for details.
4. Install ½" flexible conduit to protect wiring. See Standards page 19-101 for details.
5. All installations require two 5/8 inch square head machine bolt and one 1/2 inch x 4 inch lag screws. All required bolts and lag screws must be installed in order for bracket to withstand horizontal wind loading forces. Never drive lag screw during bracket/luminaire installation with lamp installed. Lamp life will be reduced. Always install photoelectric control last.
6. Every bracket shall be grounded. Connect #4 AWG copper bracket grounding conductor to the pole equipment grounding conductor when available. Otherwise, connect bracket equipment ground conductor to system neutral



Wiring Diagram for 120 Volt Teardrop Luminaire

Version	Date	Modification	Author(s)	Approval by

				(Name/Title)
7	7/19	• Revised entire section (repaged, renumbered Tables and Figures) • Added OH connected lighting information that was previously contained only in Section 46 in UG Standards • Changed "Municipal Owned" to "Customer Owned" • Added emergency response language • Revised electrical separation, clarifying point of ownership for Customer Owned Lighting • Added Alternate drawing for connection of customer owned riser to OH secondary • Revised wording - Final Connection to PPL secondary for Customer Owned Lighting		
6	7/18	• Added Table 1A pp 19-1. • Added Table 1B pp 19-2. • Renamed 19.3 Brackets and 19.4 outdoor Lighting pp 19-3. • Expanded Customer Owned Street Light section and added pp 19-5 thru 19-12.		
5	7/17	• Added Table 1A pp 19-1. • Added Table 1B pp 19-2. • Renamed 19.3 Brackets and 19.4 outdoor Lighting pp 19-3. • Expanded Customer Owned Street Light section and added pp 19-5 thru 19-12.		
4	7/16	• Added statement about LED luminaires 19.1.		
3	7/15	• Added information on street lighting fixture conductors. • Added grounding clips to 19-110, 19-111, 19-120, 19-130, 19-131 and 19-140.		
2	07/13	• Reorganized entire section • Added information on municipal owned street lights. • Added information on pre-stressed concrete pole installation.		

Version	Date	Modification	Author(s)	Approval by (Name/Title)
1	07/08	• Added NESC references and revised dimensions in Figure 1. • Revised mercury vapor luminaire disposal instructions under 19.1.60. • Replaced MU codes with CU codes in Tables 2 and 3 • Replaced MU codes with CU codes in Table 4 • Replaced CU code in Table 5 • Replaced CU codes in Table 6 • Replaced CU codes in Table 7 • Changed to ½" flexible conduit under on pages 19-400, 19-401, 19-410, 19-411, 19-420, 19-430, 19-440.		

Supersedes 7/18 Issue – Drawings updated to 3D.

Supersedes 17/07 Issue – Added Section 20.0.10 Scope – Distribution Lines.

20.0 GENERAL

20.0.10 Scope – Distribution Lines

This standard covers design and construction of new overhead distribution lines up to 35kV voltage classes. Distribution lines are lines generally used to supply customers through transformers that step down directly to customer service voltages. Sub-transmission lines are lines generally used to supply distribution substations, rather than supplying customers through transformers that step down directly to customer service voltages. Occasionally, a few large industrial customers are served directly from sub-transmission lines. For standards applicable to overhead sub-transmission lines at 25kV and 35kV, see Section 21.

20.0.20 Design

This section includes the basic design and construction necessary for new and existing standard overhead distribution lines operating at voltages above 15 kV to 35 kV. The distribution line utilizes crossarm and armless configurations for single and multiple phases built to 35 kV primary distribution specifications. A 25 kV distribution line will be built to 35 kV specifications even if it is operated at 25 kV.

The layout and design of distribution primary circuits should be made as part of an area plan, taking into consideration both present and future loads, and supply sources. Certain guiding policies are discussed in the Engineering Department Procedures (EDP).

20.0.30 Definitions

For the purpose of simplifying the terminology to be used in various descriptions of the following drawings, the definitions below serve as a guide:

25 kV - This designation is generally referred to primary circuit voltages from above 15 kV to 25 kV regardless if the system is effectively grounded or noneffectively grounded.

35 kV - This designation is generally referred to primary circuit voltages from above 25kV to 35 kV regardless if the system is effectively grounded or noneffectively grounded.

20.0.40 Coordination With Other Parties

Contact shall occur with communication companies and municipalities during the initial planning stages so that all parties may properly coordinate their required activities. Construction shall be coordinated to allow for maximum system reliability.

20.1 DESIGN OF PRIMARY FEEDERS

The standard 3 phase distribution feeder shall be 4 wire grounded wye with a neutral. The objective is to secure aesthetically appearing distribution lines that will provide maximum service reliability at a reasonable cost. This can be attained by routing feeders through minimum tree and traffic exposure, employing the proper type of conductors for the conditions along the route, and providing circuit capacity for normal and reasonably probable contingency conditions, including anticipated load growth.

20.1.10 Routing

The route of the feeder should be such that normally only one distribution circuit is placed on a pole line. Where this is not possible, an effort should be made such that one feeder shall serve the local load while additional express feeders in spacer cable configuration are carried through the area.

When feeder construction is necessary along the route of an existing subtransmission circuit, consider underbuilding the subtransmission circuit verses installing a duplicate pole line or major undergrounding. Vertical clearance between upper and lower circuits are recommended for worker safety and must meet NESC codes along with any local working agreements. Consult Engineering Departments for attachment approvals, recommend clearance between circuits, and working agreements.

20.1.20 Basic Impulse Insulation Level (BIL)

BIL refers to the level of overvoltage that equipment on the system is designed to withstand. Surge arresters, coordinated to the BIL of the equipment, are installed to limit the overvoltages on equipment by discharging surge current to ground.

Wood pole tops, phase-to-phase and phase-to-ground distances across cross-arms and poles, are designed to coordinate with the impulse withstand characteristics of the insulators and to provide a minimum 150 kV insulation impulse withstand value. This impulse level is based on the assumed impulse flashover strength of 20 inches or more of wood. Where lightning arresters are used and where grounding conductors are installed, the 20 inches of wood requirement does not apply for the particular conductor having the arrester. In locations where sufficient wood separation is not obtainable, the use of fiberglass strain insulators shall be installed. Fiberglass guy strain insulators shall be installed onto all new primary guy installations maintaining BIL requirements. When designing and constructing pole tops, steel crossarm braces, steel hardware, ground wires, guy wires, etc., may short out the insulation that is provided by air and wood. See Section 7 for additional information and drawings.

20.1.30 Size and Loading of Conductors

The initial load on the conductors of the feeder main and branches shall be limited to allow reasonable load growth before the maximum normal peak load limit is reached. This initial load value should allow for a minimum of 10 years of additional expected load growth. The current values for normal and emergency loads are based on consideration of economy with respect to losses and the thermal limits of the conductor. See Section 6-Primary Conductors.

A. Size of Main Line Conductors

Generally, 25-35kV new main line feeders shall utilize 477 kcmil All Aluminum (AAC) primary conductors. Additional conductors are available upon engineering approval. Existing conductors of adequate size may serve for part of any feeder main (see Section 20.3.50) and use of any other conductor size for this purpose will be considered on a case-by-case basis. See Section 6-Primary Conductors for additional information.

B. Size of Branch Line Conductors

Generally, three phase branches shall utilize #1/0 All Aluminum Alloy Conductor (AAAC) or 477 kcmil All Aluminum Conductor (AAC) primary conductors.

Generally, single phase branches shall use #1/0 AAAC conductor for expected loading up to 100A. Loadings may require the addition of one or more phases to maintain feeder balancing.

In existing branch circuits that have a conductor smaller than #2 where it is not economically feasible to reconductor the line or convert it to a higher voltage, step -down transformers (ratio) should be installed.

Supersedes 1/06 Issue – Text adjustment because of text addition on page 20-1.

C. Size of Grounded Neutral Conductors

Maintain a common neutral with **minimum splices** for effectively grounded circuits. Note: See Sections 13.4 and 13.5 for information on the bonding of circuit neutrals.

All neutral conductors shall be #1/0 aluminum except when a larger size is either existing or necessary as part of a secondary system. Example: #4/0 AAAC is used with 336.4 kcmil multiplex. Use of a larger neutral conductor, or use of any other secondary cable configuration or size, requires that National Electric Safety Code (NESC) clearances for that particular construction be met.

Although not recommended, if existing primary conductors are **smaller** than #1/0 aluminum or equivalent and a neutral conductor exists, it should be used if it is equal size or larger than the primary conductor.

If existing primary conductors are equal to or **larger** than #1/0 aluminum or equivalent and a neutral; conductor exists, it should be used if it is at least equivalent to #1/0 aluminum or #3 copper (#2 ACSR- aluminum cable steel reinforce - is acceptable).

20.1.40 Voltage Regulation and Flicker

It is suggested that a voltage profile be run for each feeder so that regulation can be reviewed. Contact Distribution Engineering.

Voltage regulation on the primary feeder shall be such that voltage to customers can be maintained to the following acceptable levels on a 120 V base:

Rhode Island - 123 V maximum, 113 V minimum

The voltage is controlled by the station load tap changers (LTC) transformers or station regulators, line regulators, and capacitors. Methods of setting regulators are discussed in the Engineering Department Procedures (EDP).

Voltages on lines serving loads such as motors, welders, etc., should be checked to see that any flicker does not exceed the limits given in Section 10. Loads that may cause excessive flicker should be referred to the Distribution Engineering Department.

20.1.50 Radio and Television Interference

Radio and television interference can be caused by loosely connected equipment and materials allowing arcing between parts. The higher the primary voltage, the greater the possibility of creating radio and television interference. This interference can be controlled by taking reasonable care to minimize the creation of sharp projections of energized parts by properly applying insulator ties, by making certain all bolted connections on structures are properly tightened, and by maintaining suitable clearances of pole hardware.

20.2 POLE TOPS

The following can be used for pole top constructions and pole considerations.

20.2.10 Selection of Sole Owned and Jointly Owned Poles

There is no standard pole height or class that can positively meet all construction conditions without causing unnecessary expense. Selection of pole height and class requires the coordination of all pole users. Once the correct pole height and class is determined for the most common pole in the project, the remaining pole heights and classes should be easily determined with small changes made to the original calculations. See Section 2 for pole selection information.

Existing poles in sound condition and in the proper locations should be used if pole loading and minimum clearance requirements can be met for the facilities that are being installed.

Prior to changing a jointly owned pole, it should be determined that the communications company is not occupying the Company's space. If the pole must be replaced, or if new poles are to be installed, they shall be selected to provide clearances specified for present and future needs following the Joint Use Contractual Agreements. The Company may be entitled to reimbursement of transfer costs.

Whenever present and future construction requires more pole space, wood pole top extensions should be considered before a new larger pole is installed.

20.2.20 Crossarm Construction

The standard primary 3 phase construction is bare wire on a crossarm, which for a straight line pole consists of a 2-pin-10 foot wood crossarm with wood braces and a 24 inch steel pole top pin, steel crossarm pins, porcelain pin-type insulators for above 15kV to 35kV distribution. This type of construction is also recommended for long span rural lines, for lines in heavy industrial areas, and for locations where its appearance is not objectionable. It may also be necessary to continue this type of construction on existing lines that are rebuilt to maintain consistency of existing crossarm construction. See 9-400 series.

At line angles over 20 degrees, primary deadends, railroad crossings, and limited access highway crossings, double crossarms are required (NESC 261.D.5.c). Double crossarms are also required at navigable waterways requiring waterway crossing permits (NESC 241.C).

Other crossarm sizes and arrangements may be used as field conditions require. They are:

1. Six -Pin Heavy Duty (HD) Crossarm (10 foot) – Use for 3000 lbs Deadends construction.
2. Extension Arms (Alley Arms) – Use when this is the only practical method of obtaining clearance from trees, buildings, etc., or for reducing or eliminating an angle in the line. In general, two or more adjacent poles with extension arms shall be used to reduce the excessive lateral stress, which may be caused by one extension arm in a straight line. Side guys or equivalent may be required to support the unbalanced load of a series of extension arms. (9-440 series)
3. Offset Arms – Use 6 pin with wood braces when the full offset of an extension arm is not required. Refer to Section 7 for adequate BIL separation. See 9-441 for Offset Arm construction drawings.

20.2.30 Armless Construction

Single phase armless (vertical) construction, utilizing steel pole top pin, is recommended. Pages 9-700 series have various diagrams pertaining to effectively grounded circuits.

20.2.40 Spacer Cable Construction

Spacer Cable construction is preferred for distribution lines when NESC Clearances, Tree Trimming Clearances, and Right of Way Issues can not be resolved with the recommended crossarm or armless types of construction. It may also be selected for an additional express feeder purpose and/or **to improve reliability in an area**

20.2.50 Phase Position

Circuits should hold the same relative phase position throughout their entire length as far as practicable following the guidelines shown on Page 20-105. Where there is an established policy on phase position in any operating area, it may be continued.

20.3 TYPES OF CONDUCTORS

The type of conductor shall be selected as follows:

20.3.10 Bare Conductors

Bare open wire primary conductors shall be used where tree conditions do not exist, or where tree conditions are not expected to exist for many years. These areas include roads along cultivated fields, orchards and vineyards, heavily pave areas, and areas regularly trimmed by others. In such areas, these lines are almost trouble-free and they represent the most economical type of construction.

20.3.20 Covered Conductors

PE covered conductor is not approved for new installations but for maintenance purposes only. This conductor is designed to withstand a limited amount of incidental contact.

20.3.30 Tree Conductor

Tree conductor is an approved conductor for new installations on crossarms and armless construction. This conductor is designed to withstand incidental tree contact but is not intended to be installed to permanently eliminate tree trimming. Tree conductor may also be installed when local municipal ordinances mandates that covered primary conductors be installed.

Tree conductor is the only wire to be used in a spacer cable configuration. Spacer cable configuration provides maximum reliability and is to be used in heavy tree areas but is not intended to be installed to permanently eliminate tree trimming. See Section 16-Aerial/Spacer Cable. Tree conductor in a spacer cable configuration is also approved for express or multiple feeder installation on existing poles.

Although tree conductor offers some electrical protection, **it is not an insulated conductor**. It must be treated as a bare conductor during installation and maintenance.

Tree conductor contains a layer of semi-conducting material at the aluminum conductor surface. **WARNING: When skinning these conductor coverings, do not allow the removed covering to contact equipment grounds or adjacent live phase conductors as an electrical flash may result.**

20.3.40 Preassembled Lashed Aerial Cable (PLAC)

Preassembled Lashed Aerial Cable is not available for 35kV distribution at this time.

20.3.50 Existing Conductors

Primary conductors smaller than #1/0 is not recommended to be operated on 25-35kV Distribution Systems. Consider replacement of conductors smaller than #1/0, if economically feasible, or the installation of step-down transformers

20.4 Separation of Conductors

20.4.10 General

Minimum recommended separations between supports and conductors on the same pole are shown on the construction drawings. These should be used on all poles for new lines. They are generally used for pole replacements.

20.4.20 Separation on New Poles

The separation between primary line conductors and neutrals or secondaries on poles for new lines shall generally not be less than 61 inch for 35 kV. These distances are predicated upon the NESC Phase to Ground Approach Distance, plus the dimension of "Reach" based upon the average distance from a line worker's chest to their finger tips with the arms extended.
e.g. (NESC Phase to Ground Approach Distance for 35 kV = 31") + (Reach =30") = 61"

A. Tangent Poles (wires on pins and crossarms) – the vertical separation between the thru bolts for the primary crossarm and the secondary conductor shall be not less than 51 inches for 35 kV.
e.g. 35 kV - The distance from the horizontal center of the crossarm to the top of the insulator holding the primary conductor is 10" + 51" = 61".

B. Primary Deadend - the vertical separation between the thru bolts for the primary crossarm and the secondary conductor shall be not less than 61 inch for 35 kV.

20.4.30 Separation on Existing Poles

When pole tops are being rearranged to accommodate additional facilities or when circuits are cut over to a higher voltage level, the recommended separations between primary line conductors and neutrals or secondaries for work on **New Poles must** be used if possible. This will hold future work to a minimum and allow work on secondaries without covering the primaries (NESC Approach Distance). However, extensive work and pole change outs should not be undertaken solely to reduce work that might possible become necessary in the future. If the primary to secondary/neutral separation for **New Poles** cannot be obtained, reduce spacing can be utilized which may require transformers to be rotated to maintain proper NESC clearances. The minimum separations between conductors and supports on the same pole should be used only when values recommended for new poles are not practicable. See the following for guidelines:

Generally, the basic primary to secondary conductor separation may be reduced to 53 inches for 35 kV. This minimum separation may accommodate third party attachments without pole replacements.

20.4.40 Space Available on Jointly Owned Poles

Before replacing any jointly owned poles, be certain that communication company attachments cannot be moved to permit the desired construction (Ref.NESC rule 239 F.2 and Table 235 -5)

20.4.50 Separation on Replaced Poles

The separations on poles that are replaced should conform to the requirements for new poles. In some special cases, separation may be reduced, but shall not be less than permitted on existing poles.

20.4.60 Reduction of Separation on Poles

Reduced separations of conductors and facilities made to accommodate communication, CATV or other third party interest shall not be less than "Minimum Dimensions for Existing Poles".

20.5. Other

20.5.10 Surge Arresters

See Section 13

20.5.20 Insulators

A. Bare Conductor – One piece radio free, pin type, porcelain insulators of the appropriate ANSI class shall be used to support the phase conductors. A one piece polymer deadend insulator of proper voltage rating shall be used to deadend the conductor.

B. Tree Wire and Spacer Cable – A one piece, plain top, pin type, polyethylene insulator of the appropriate ANSI class shall be used to support the phase conductor. A one piece polymer deadend insulator of proper voltage rating shall be used to deadend the conductor.

Where severe environmental contamination exists, Line Post Insulators (I13D) with ¾" Studs (P1G) and Pole Top Pins (P12B) should be considered.

20.5.30 Neutral Brackets

An uninsulated metal bracket shall be used to support the common neutral conductor in the secondary position. See Section 10 for information on Secondary.

20.5.40 Conductor Ties

Follow these guidelines to ensure the reliability of primary circuits and to reduce or eliminate interruptions caused by inadequate conductor tie practices.

Line conductors are to be positioned on its insulators that will produce minimum strain on the tie wires. The function of the tie wire is only to hold the line conductor on its insulator. Conductor strain shall be taken by the insulator and pin.

Hand wrapped ties are to be used for all types of conductor on lines operating at higher voltages where they are worked dead and grounded. Ties are to be made by hand and without the use of pliers. A tie wire must be neatly and tightly wrapped around the insulator and conductor with free ends wrapped tightly around the conductor. The free ends shall be folded back on the conductor at a distance of 3 inches to facilitate the future removal of the tie with hot sticks.

Hot line ties are to be used when lines are being worked with hot sticks. These also need to be wrapped neatly and tightly around the insulator and conductor. Single loop ties are to be recommended for spans under 160 feet while double loop ties are recommended for conductors with spans of 160 feet and over.

Utilize preformed conductor ties (TT1) for 3000 lb construction.

Care shall be taken to use the proper length and size tie for each conductor specified in the tables on Page 20-120. Refer to Pages 20-118 thru 20-124 for diagrams and information on Hand Wrapped and Hot Line Ties.

Note:

1. Type Tie – Bridle tie shall be used for all bare and covered conductors larger than #4 AWG regardless of span length.
2. Looped Western Union and Cross Top Tie shall be used for all bare and covered conductors # 4 AWG or smaller (#4, #6, etc.).
2. Bare Conductor – Use bare tie wire. (W22A, W22BA, W22C)
3. Tree Wire – Use covered tie wire. **Note:** Do **not** use molded plastic ties. Do **not** remove tree wire covering at polyethylene pin type insulator. (W22D)
4. Existing Polyethylene and Neoprene Covered Line - Wire to be converted to the 35 kV Voltage class – Install 35 kV pin type polyethylene insulator and tie with covered tie wire (W22D) where existing covering on conductor has not been previously removed. Where covering has been removed, pin type porcelain insulator and tie with bare tie wire.
5. Double insulators shall use ties for single insulators with each tie occupying one-half the available space between insulators – same number of turns with closer spacing.

20.5.50 Splicing Conductors

A. Bare Conductors – Use automatic line splice or full tension compression splice per Section 5.

B. Tree and Covered Conductors – Remove covering with approved stripper for given conductor size and covering thickness. Completed splice should have 3 inches of bare conductor on both sides of the splice. DO NOT install splice at or near polyethylene pin insulator but keep the splice a minimum distance of 30 inches from pin insulator. Splices for additional phases should be staggered a minimum distance of 30 inches apart. **Warning: Always cover unused exposed bare conductors** outlined in Section 5. Use automatic line splice or full tension compression splice per Section 5. See Section 16 for more information on Tree Wire.

C. Spacer Cable – Follow procedures outlined in Section 16 when Tree Wire is installed in a spacer cable configuration. An automatic line splice **must not** be used because only the messenger is under tension and not the phase conductors.

20.5.60 Deadending Conductors

A. Bare Conductors – Use conventional strain clamps specified in Section 22 - Material Catalog of the Standards.

B. Tree and Covered Wire – Remove covering with approved stripper for given conductor size and covering thickness. Use conventional strain clamps chosen from the Material Section of the Standards Manual. Completed deadend shall allow 3 inches of covering removed on the line side of the strain clamp body to accommodate for grounds and jumpers. Do not use preformed deadend grips for tension applications.

C. Spacer Cable – Follow procedures outlined in Section 16 when Tree Wire is installed in a spacer cable configuration.

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20.5.70 Tapping Conductor

A. Bare Conductors – Use connectors as specified per Section 5 of the Standards.

B. Tree and Covered Conductors – Remove covering with approved stripper for given conductor size and covering thickness. Use connectors as specified per Section 5 of the Standards. Installed connector shall allow 3 inches of bare conductor on both sides of connector ends to accommodate for grounds and jumpers. Do not tape completed connections.

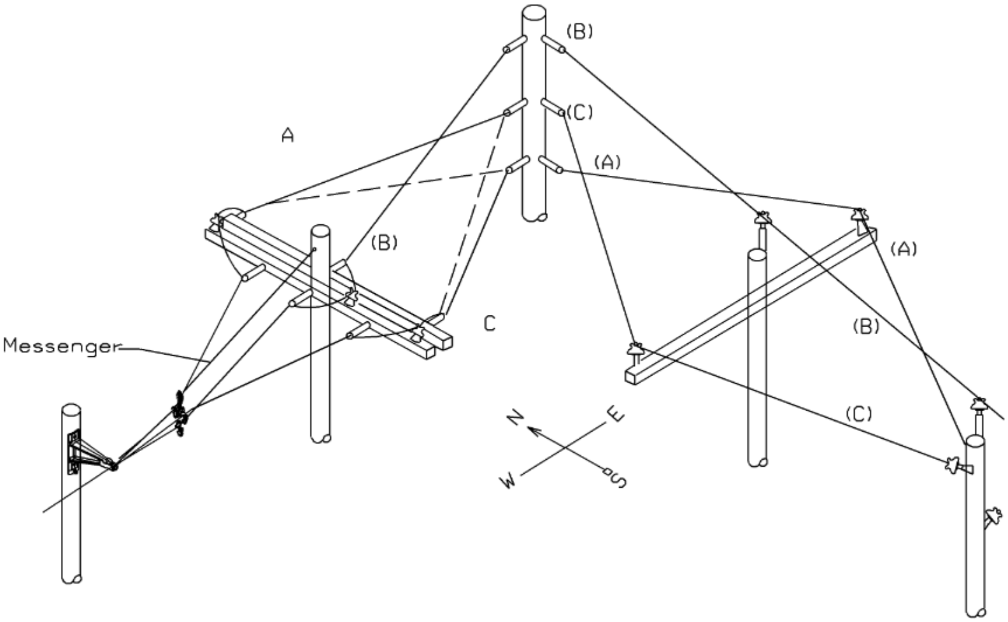
C. Spacer Cable – Follow procedures outlined in Section 16 when Tree Wire is installed in a spacer cable configuration.

20.5.80 Conductors Installed in Angle Suspension Clamps

A. Bare Conductors - Use appropriate angle suspension clamp. See Section 22 - Material Catalog.

B. Tree and Covered Conductors - Remove covering with approved stripper for given conductor size and covering thickness. Use appropriate angle suspension clamp specified in the Material section of the Standards. Complete clamp installation shall allow for 3 inches of bare conductor on both sides of clamp ends.

C. Spacer Cable – Follow procedures outlined in Section 16 when Tree Wire is installed in a spacer cable configuration.

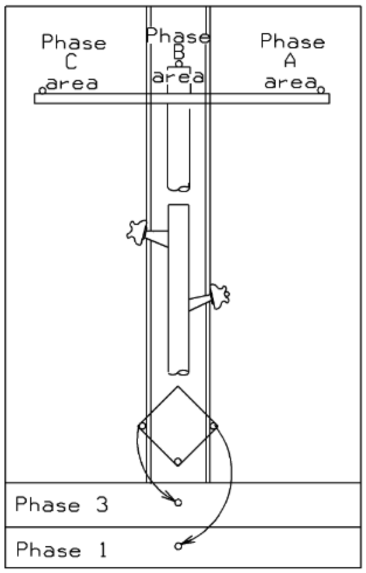


Notes:
If there are local rules that have been approved by the division superintendent, these should be followed where practicable. Otherwise use the rules below:

(1) Put phase A on the northerly or easterly side for horizontal crossarm or spacer cable installation. Put phase A on the bottom for vertical construction.

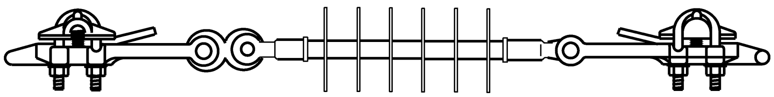
(2) Put phase B in the middle or top positoin for horizontal crossarm or for vertical construction. Phase B shall occupy the middle and bottom position for spacer cable in triangular arrangments.

(3) Put phase C in the remaining position.

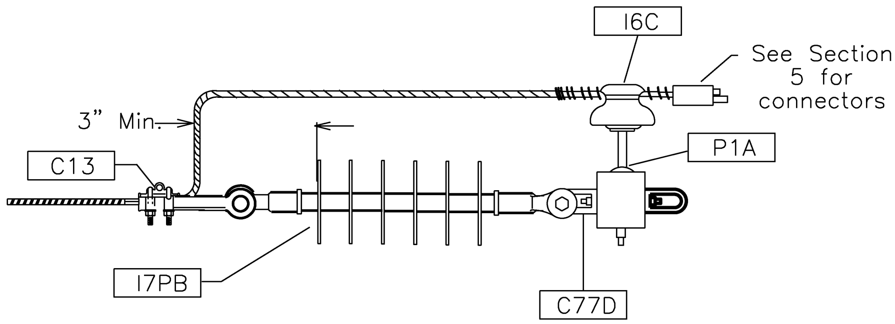


Look north
Look east
Look west

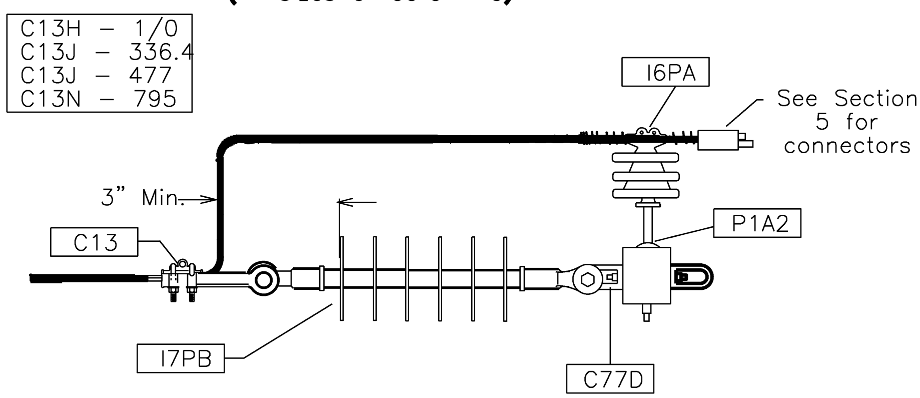
PHASE POSTITONS 25-35 kV DISTRIBUTION PRIMARY			
ISSUE	**PAGE NUMBER**	**OVERHEAD CONSTRUCTION STANDARD**	ppl
7/07	**20-105**		



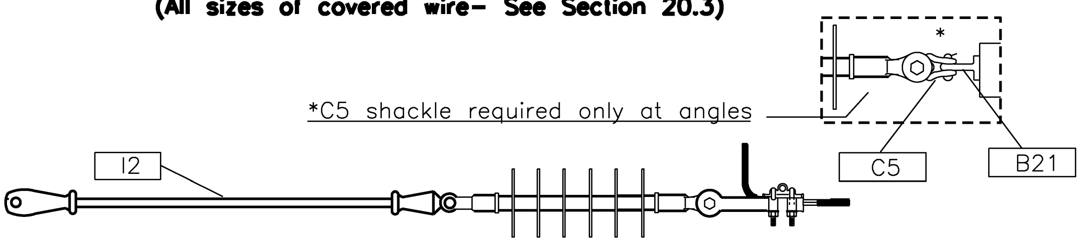
Inline Dead Ends



Dead-End Clamps
(All sizes of bare wire)



Dead-End Clamps
(All sizes of covered wire- See Section 20.3)

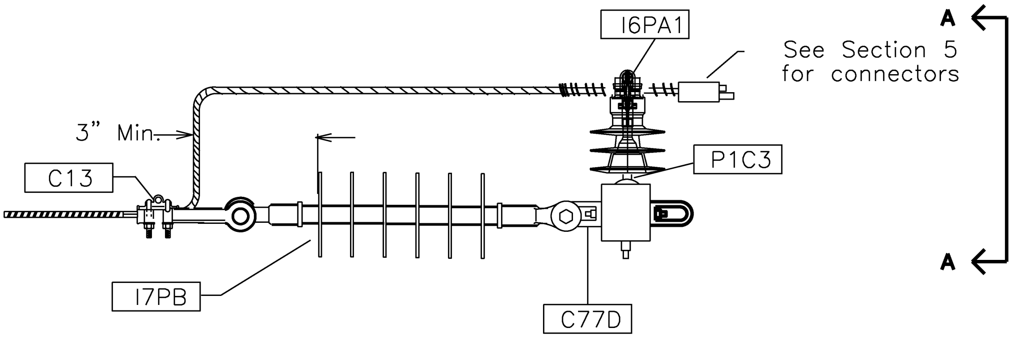


Inline Dead Ends

Notes:

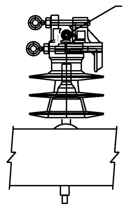
Maintain full impulse and flashover strength; see Section 7.
This drawing is for dead–ends on wood crossarms or wood poles.

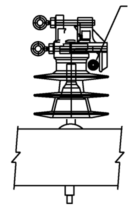
See 2.8 for information on crossarm.
Use 10 foot fiberglass crossarm (C77D)
for 3000 lb construction.



Dead-End Clamps with 35kV Vise-Top Insulator
(All sizes of bare/covered wire)

C13H	1/0
C13J	336.4
C13J	477
C13N	795





7/19 - New Page

Notes:

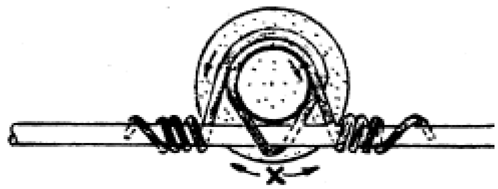
Always install bottom bolt first. Top bolt second, breaking eyes off bolts. Orient insulator so cable rests on neck or side of insulator.

Maintain full impulse and flash over strength; see Section 7.
This drawing is for dead-ends on wood crossarms or wood poles.

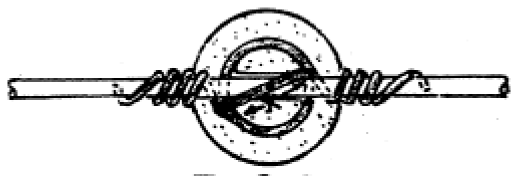
See 2.8 for information on crossarm.
Use 10 foot fiberglass crossarm (C77D)
for 3000 lb construction.

Designer	Drawing	Date
MPR	od20116	7/15/19

HAND WRAPPED TIES

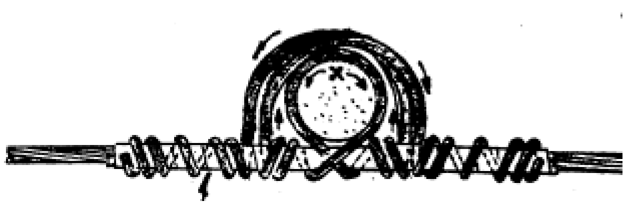


LOOPED WESTERN UNION (LWU) - SIDE GROOVE TIE
FIG I



CROSS TOP (CT) TOP GROOVE TIE
FIG II

FIG I & II TO BE USED FOR ALL BARE AND COVERED CONDUCTOR OF #4 AWG OR SMALLER.



BRIDLE TIE SIDE GROOVE
FIG III

BRIDLE TIE TOP GROOVE
FIG IV

FIG III & IV TO BE USED ON ALL COPPER & ALUMINUM CONDUCTORS LARGER THAN #4 AWG

TIE CONDUCTORS

TABLE I – LENGTH AND TYPE - FOR BARE LINE CONDUCTOR

Line Conductor Size AWG-kcmil	Tie Wire Size AWG	Std Item	Class 55-6 Insulator – 35kV			
			Side Groove		Top Groove	
			Length (Inches)	Type	Length (Inches)	Type
# 6 Cu	# 6 Cu	W22A	-	-	-	-
# 6A CW &CCW	# 6 Cu	W22A	-	-	-	-
# 4 Cu	# 6 Cu	W22A	-	-	-	-
# 3 Cu	# 6 Cu	W22A	58	Bridle	46	Bridle
# 2 Cu	# 4 Cu	W22BA	68	Bridle	55	Bridle
# 1/0 Cu	# 4 Cu	W22BA	73	Bridle	63	Bridle
# 4/0 Cu	# 4 Cu	W22BA	79	Bridle	67	Bridle
Larger Cu	# 4 Cu	W22BA	-	-	-	-
# 4 ACSR	#4 AL	W22C	62	Bridle	53	Bridle
# 2 ACSR	#4 AL	W22C	65	Bridle	56	Bridle
# 1/0 ACSR	#4 AL	W22C	69	Bridle	59	Bridle
# 4/0 AL (AAC)	#4 AL	W22C	81	Bridle	69	Bridle
336.4 AL (AAC)	#4 AL	W22C	89	Bridle	77	Bridle
336.4 ACSR3000#	#4 AL	TT1B	Preform	Bridle	Preform	Bridle
477.0 AL (AAC)	#4 AL	W22C	108	Bridle	96	Bridle
795 AAC	#4 AL	W22C	108	Bridle	96	Bridle

TABLE II – LENGTH AND TYPE - FOR COVERED AND TREE LINE CONDUCTOR

Note: If insulation is removed 30", use bare tie wire (see above)

Line Conductor Size AWG-kcmil	Tie Wire Size AWG	Std Item	Class 55-6 Insulator – 35kV			
			Side Groove		Top Groove	
			Length (Inches)	Type	Length (Inches)	Type
# 6 Cu	#4 AL TPR	W22D	-	-	-	-
# 6A CW &CCW	#4 AL TPR	W22D	-	-	-	-
# 4 Cu	#4 AL TPR	W22D	-	-	-	-
# 3 Cu	#4 AL TPR	W22D	58	Bridle	46	Bridle
# 2 Cu	#4 AL TPR	W22D	68	Bridle	55	Bridle
# 1/0 Cu	#4 AL TPR	W22D	73	Bridle	63	Bridle
# 4/0 Cu	#4 AL TPR	W22D	79	Bridle	67	Bridle
Larger Cu	#4 AL TPR	W22D	-	-	-	-
# 4 ACSR	#4 AL TPR	W22D	62	Bridle	53	Bridle
# 2 ACSR	#4 AL TPR	W22D	65	Bridle	56	Bridle
# 1/0 ACSR	#4 AL TPR	W22D	69	Bridle	59	Bridle
# 4/0 AL (AAC)	#4 AL TPR	W22D	81	Bridle	69	Bridle
336.4 AL (AAC)	#4 AL TPR	W22D	89	Bridle	77	Bridle
336.4 ACSR	#4 AL TPR	W22D	89	Bridle	77	Bridle
477.0 AL (AAC)	#4 AL TPR	W22D	108	Bridle	96	Bridle
795 AAC	#4 AL TPR	W22D	108	Bridle	96	Bridle

SINGLE LOOP HOT LINE TIES

1. **<u>USE SINGLE LOOP TIES FOR SPANS UNDER 160 FEET</u>**. where lines are to be worked hot. Use double ties for spans over 160 feet. and for all angle poles.

Approx. ¾” Diameter.

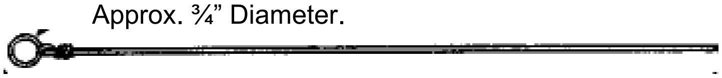


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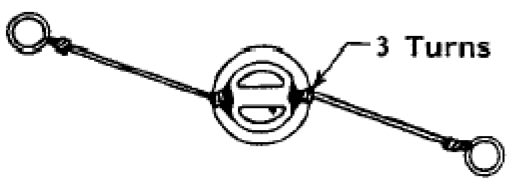
Figure A – Prepare Loop – Two Required



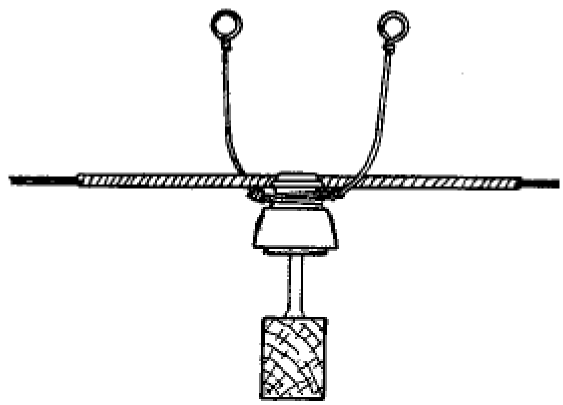


Figure B – Loops In Place On Insulator

Figure C – Conductor In Place

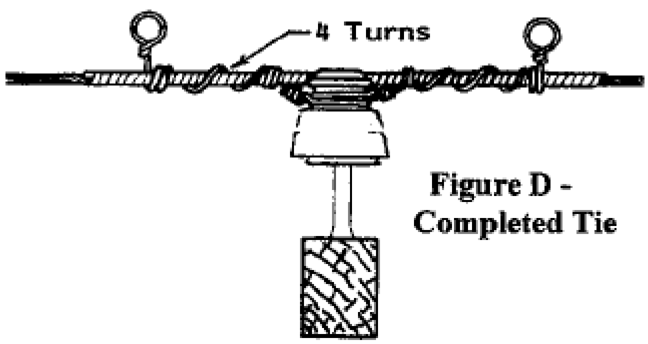


Figure D - Completed Tie

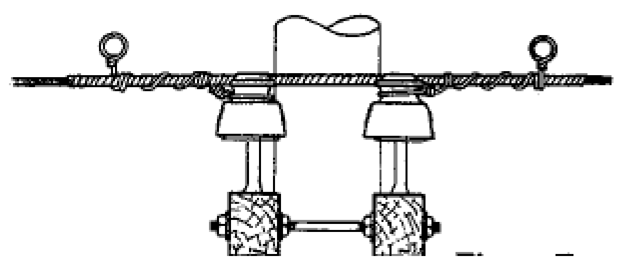


Figure E – On Double Arms

Line Wire Size AWG-kcmil	Tie Wire Size AWG-kcmil	Length “K” (Inches)			Line Wire Size AWG-kcmil	Tie Wire Size AWG-kcmil	Length “K” (Inches)
#3 Copper	#6 Copper	32			#1/0 6201 Al.	#4 Alum.	34
#1/0 Copper	#4 Copper	36			#4/0 6201 Al.	#4 Alum	40
#4/0 Copper	#4 Copper	40			336.4 ECA	#4 Alum	44
#4 ACSR	#4 Alum.	28			477.0 ECA	#4 Alum	46
#1/0 ACSR	#4 Alum.	34					

DOUBLE LOOP HOT LINE TIES

1. **<u>USE DOUBLE LOOP TIES FOR SPANS OVER 160 FEET</u>**. where lines are to be worked on hot and for all angle poles. Use single ties for spans under 160 feet.

Approx. ¾" Dia.
2 - Full Turns
Figure A- Prepare Loop – Two Required

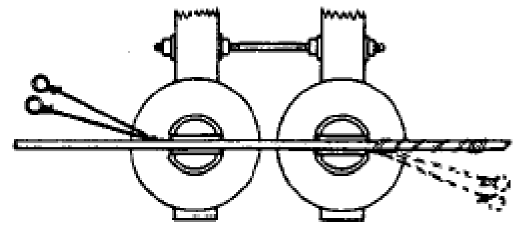


Figure E – Double Insulators Conductor In Place – Top Groove

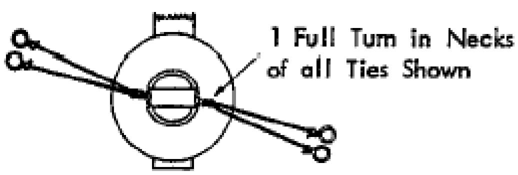


Figure B – Loops In Place On Insulator (Top View)

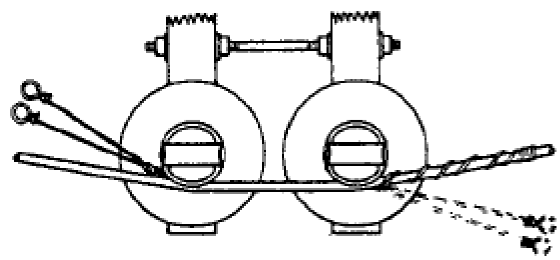


Figure F – Double Insulators Conductor In Place – Side Groove

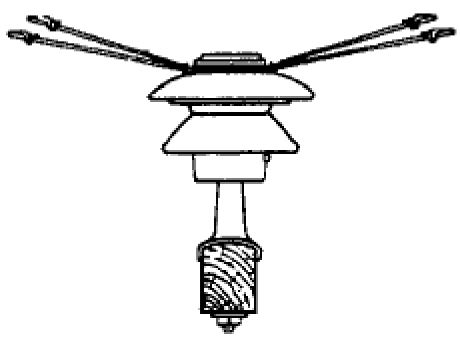


Figure C – Loops In Place On Insulator

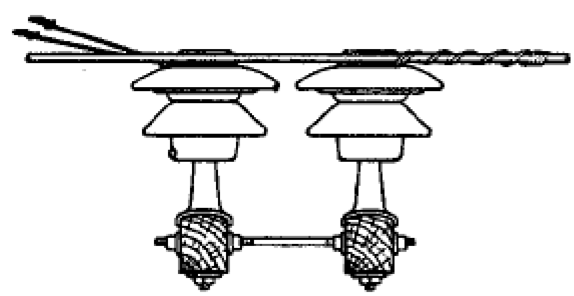


Figure G – Double Insulators Elevation

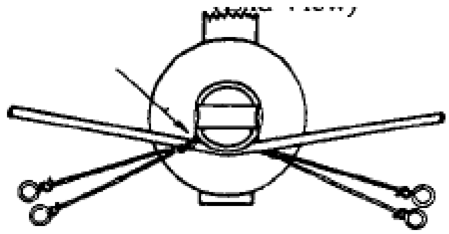


Figure D – Conductor In Place (In Side Groove For Angle In Line)

Pole spans are limited primarily by the sag characteristics of the primary conductor relative to the horizontal and vertical separations provided by the standard pole top arrangement. Increases in separations at the pole may permit longer spans. Transverse wind loadings may not allow use of extremely long spans

Maximum spans are determined by the following criteria:

Horizontal Clearance (Distance between Phase Conductors at the same level):
Maximum spans are based on the HORIZONTAL clearance of the primary conductors outlined in the NESC (National Electrical Safety Code) rule 235B.

The clearance at the supports of conductors of the same or different circuits of Grade B or C in no case shall be less than the values given by the following formulas, at a conductor temperature of 15°C (60°F), final unloaded sag, and no wind. The clearance shown in Table 235-1 (NESC) shall be used if they give a greater separation than below formulas.
See the formulas below for the appropriate applicable situation:
For conductors smaller than AWG #2: clearance (c) = 0.3 inches per kilovolt + 4.04 $\sqrt{s-24}$.
For conductors of AWG #2 and larger: clearance (c) = 0.3 inches per kilovolt + 8 $\sqrt{s/12}$.
c = Horizontal clearance between the primary conductors in inches.
s = Apparent Sag of the conductor in inches having the greater sag.

Clearances are between conductors located at the same level (i.e. the two outside phase conductors on standard crossarm/armless pole top construction or two nearest phases in crossarm deadend construction).

Vertical Clearance (Primary vs Secondary): Maximum operating temperature. See section 6
Maximum spans are based on the VERTICAL clearance between primary and 600 V secondary or neutral conductors outlined in the NESC (National Electrical Safety Code) rule 235C. The separation is given for the spacing shown on the pole top drawings in this section while maintaining 16 inch minimum mid-span clearance as shown in the Section 7. Clearances are taken between conductors that are directly above and below each other and are based on the sag of the primary conductor and either 600 V secondary or neutral conductors. Combinations of conductor sag verse span may be calculated using the sag data provided in Section 6-Conductors.

A comparison of sag between two different operating conditions need to be evaluated and the one requiring the greater separation at the structure needs to be used. They are to be compared as follows:

> The upper conductor is at final sag at the maximum operating temperature for which the line is designed to operate and the lower conductor is at final sag at the same ambient conditions as the upper conductor without electrical loading– or
>
> The upper conductor is at final sag at 32° F with the radial thickness of ice, and the lower conductor is at final sag at the same ambient conditions as the upper conductor without electrical loading, and without ice loading.

Generally, the sag of primary conductor for both bare and tree wire at maximum operating temperature of 194° F (90° C) would be greater than conductor under “Heavy Loading” operating conditions. A comparison should be made.

If the operating temperature sag is greater, determine the upper primary conductor sag based on the 194°F (90°C) for bare or tree primary conductor and the lower secondary or neutral conductor at 32° F (0° C) of the same ambient temperature of 32° F for upper and lower conductor. See Section 6 for “Loading (Unloaded Conditions)” and “Loading (Loaded Conditions)” sag charts.

For span lengths in excess of 150’, a supply conductor above 750V but less than 50kV shall not sag lower in the span than a straight line joining the points of support of the highest communication cable or conductor. The conductor sag is based upon the sag data obtained from a conductor temperature of 60°F (15°C), no wind displacement and final unloaded sag conditions.

Vertical Clearance (Secondary Vs Communications):

New Plant - maximum spans are based on the vertical clearance between the 600V Secondary or Neutral conductor and the communication conductor's In-Line-Of-Site from adjoining structures. The conductor in the secondary position should not sag closer than 30" to the Communication Conductor's "In–Line-Of-Site" at mid-span utilizing the 32°F (0°C) Loading (Unloaded Conditions) sag data.

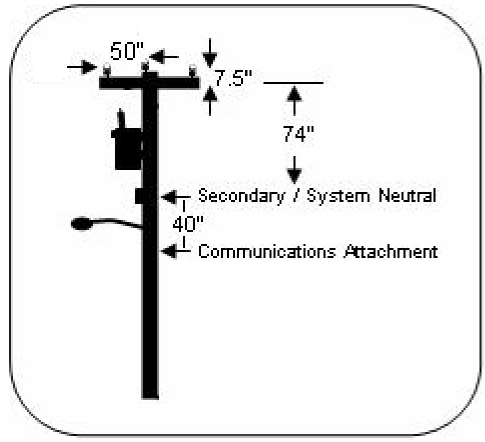
Existing Plant – may sag below Communication Conductor's "In-Line-Of-Site" but must maintain the NESC clearance of 30" mid-span between the communication and Secondary Conductors.

For either condition of New Plant or Existing Plant, longer spans can occur by either increasing the pole height, relocating conductor per the "Minimum Dimension" spacing, or consult the respective communication company for their cable sag requirements agreeing the sag of their cable will follow the sag of the conductor in the secondary position. This will allow the cable to have a 30" mid span clearance which is 75% of the separation at the adjoining structures of 40".

Communication conductor in line of site is defined as a straight line joining points of support of the highest communication cable or conductor. Consult the communications company for sag of their conductor.

Given:

35 kV class construction
Primary Voltage – 34.5kV effectively grounded
Pole Framed 20-411A
Grade C construction
1 – 40 ft., class 3 wood pole JT NE (84" Allocated)
3 – 477 kcmil AAC bare conductors (W21BA)
1/0 AAAC triplex secondary cable (W15C)
Ø to Ø Primary Horizontal Separation = 50" (20-206)
Vertical Pole Spacing (74"+10" = 84")
(10" = thru bolt of xarm to conductor on top of insulator)
40" of Neutral Spacing (Bottom Secondary Bracket to top of comm.
300' of 477 kcmil Bare AAC Sag @ final Unloaded Sag@60°F with no wind. =121.92 (6-114). (Design Ruling Span)
135' Span
*135' - 477kcm B AAC Sag @ 176°F (90°C) Final Unloaded = 53"
*135' - #1/0 AAAC Triplex Sag @ 30° = 12"
* = Calculated Values. (Steps 5-7)



Maximum Span Contingent on Horizontal Primary Conductors Separation: Steps 1-4

Step	Action	Use
1	Determine maximum Primary Conductor sag based on 50" of primary horizontal conductor separation Section 20-206.	NESC 235Bb2: #2 AWG and greater. $\boxed{s=12*\left(\frac{(c-.3k)_v}{8}\right)^2}$
2	Calculate maximum allowable primary sag	s= Apparent Sag in Inches = unknown c=Primary phase to phase separation based on 20-206 = 50" k=Kilovolt of circuit = 35kV $s=(12)x\left(\frac{50in.-.3x35kV}{8}\right)^2$ = $(12)x\left(\frac{50-10.5}{8}\right)^2$ $s=292.5''$ (293")
3	Determine maximum span based on Primary conductor sag of 292.5" (293") for 477kcmil AAC Bare Primary Conductor.	$\boxed{S_m=S_r*\sqrt{\frac{D_m}{D_r}}}$ S_m = Maximum Allowable Span S_r= Design Ruling Span D_m= Defined Sag Limit D_r= Design Ruling Span Sag @ final Unloaded Sag@60°F with no wind.
4	Calculate Maximum Span (Maximum Span based solely on Horizontal Separation. Not influenced with Vertical Separation)	S_m = 300 * $\sqrt{293/121.92}$ S_m = 300 * $\sqrt{2.4}$ S_m = 300 * 1.55 S_m = 464.75'(465') .

Determine Sag of Actual Span versus Ruling Span: Steps 5-7

Step	Action	Use
5	Determine Sag of "Other Span". (135' section)	$S_a = \frac{L_a^2}{L_r^2} * S_r$ S_a = Sag of Actual Span S_r = Sag of Ruling Span L_a = Length of Actual Span L_r = Length of Ruling Span
6	Calculate 135' - 477kcm B AAC Sag @ 194°F (90°C) Final Unloaded (See 6-114)	S_a = Sag of Actual Span = Unknown S_r = Sag of Ruling Span = 45.24" (125' Ruling span) L_a = Length of Actual Span = 135' L_r = Length of Ruling Span = 125' $S_a = \frac{L_a^2}{L_r^2} * S_r$ $S_a = \frac{135^2}{125^2} * 45.24_k$ S_a = 52.77" **= 53"**
7	Calculate 135' - #1/0 AAC Triplex Sag @ 30°F .(0°C) (See 10-6)	S_a = Sag of Actual Span = Unknown S_r = Sag of Ruling Span = 10" L_a = Length of Actual Span = 135' L_r = Length of Ruling Span = 125', $S_a = \frac{L_a^2}{L_r^2} * S_r$ $S_a = \frac{135^2}{125^2} * 10$ S_a = 11.64" **= 12"**

Determine 34.5kV Effectively Grounded Phase to Secondary/Neutral (Supply) NESC Clearance: Steps 8-9

Step	Action	Use
8	Determine NESC required phase to 0-750V secondary (Supply) clearance per NESC requirements at the **structure**. (See Table 9 – page 7-19 in the Overhead Construction Standards)	34.5kV/19.9kV effectively grounded distribution circuit Structure Clearance = 16" + .(4" per KV). See Table 9 page 7-19 Structure Clearance = 16" + (.4 X 19.9 – 8.7) Structure Clearance = 16" + 4.48 Structure Clearance = 20.48" (20.5")
9	Determine NESC Mid-Span Clearances. (See Table 9 – page 7-19 in the Overhead Construction Standards)	Mid-Span clearance = 75% X Structure Clearance Mid-Span clearance = 75% X 20.5" Mid-Span clearance = 15.375" (16")

Maximum Span Contingent on Vertical Conductor Separation between Primary – Secondary – Communication Conductors : Steps 10-12

•

Step	Action	Use
10	Calculate Sagged Primary Conductor Above or Below Secondary Line-Of-Site.	Vertical Pole Spacing = 82” Primary Conductor Sag = 53” Sagged Primary Conductor **ABOVE** Sec Line-of-Site = 29”
11	Calculate Mid Span Conductor Separation between Primary and Secondary	Sagged Primary Conductor Above Sec Line-Of-Site = 29” Secondary Conductor Sag = 12” Mid Span Vertical Separation between Pri & Sec = 41” (16” minimum required per Section 7)
12	Calculate Mid Span Conductor Separation between Secondary and Communication’s Conductor Line-Of-Site	Vertical Separation between Sec Conductor and Line-Of-Site for communications conductor (40” vertical +2” from Sec cond to bottom of Sec Bracket) = 42” Secondary Conductor Sag = 12” Mid Span Vertical Separation between Pri & Sec = 30” (30” minimum required per Section 7)

Determine Clearance between Sagged Primary Conductor and Communication’s In-Line-of-Site (>150’ & >750V NESC Rule 235C.2.b.3): Steps 13-14

Step	Action	Use
13	Determine maximum vertical separation between primary positions on pole to Communication’s Line-Of-Site.	Conductor Position On Insulator = 8.0” Framing Vertical Pole Spacing (Framing) = 74.0” Allocated Space = 2.5” Communication’s Neutral spacing (Line-of-Site) = 40.0” Total Space to Communication’s Line-of-Site 124.5”
14	Calculate sagged Primary Conductor position relative to Communication’s Line-Of-Site. (NESC 235.C.2b.3 - Supply Cable exceeding 750V and less than 50kV for spans exceeding 150’ shall not sag below communication’s In-Line-of-Site)	175’ - 477 B AAC sag @ 60°F (15°C) no wind displacement and final unloaded. = 45” Total Space to Communication’s Line-of-Site =124.5” Primary Conductor Sag = 45.0” Mid Span Vertical Clearance between sagged Primary = 79.5” And Communication’s Line-of-Site (Above Line-of-Site -0” Minimum)

Conclusion:

Horizontal – The horizontal clearance of 50" will allow a maximum span of 465' for 477 B AAC before mid span contact becomes an issue between primary conductors. This calculated value, per NESC guidelines, is well beyond the span of 135' in the above example. (Steps 1 - 4)

Vertical – There are several vertical clearances that need to be evaluated regarding maximum spans. They are as follows:

` Primary vs Secondary – The vertical mid span clearance between the primary and secondary conductor was calculated to be 29" for a span of 135' in the above example. The NESC minimum clearance shown in Section 7, Page 7-19 indicates 16" is the minimum required at mid span. Therefore, mid span contact between primary and the conductor in the secondary position is not an issue in the above example. (Step 10 & 11)

Secondary Vs Communications

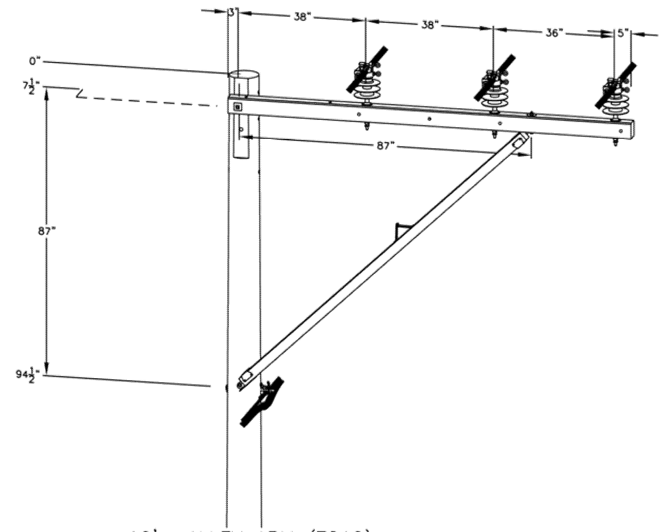
750V Line –of –Site Rule: This calculation to determine the relative position of the sagged primary conductor to the highest Communication's Cable position for a straight line joining the points of support were not necessary because the span was under 150'. NESC Code requires this clearance to be calculated if the span is greater than 150' and the supply cable is greater than 750V but less than 50KV. The calculation was shown to demonstrate how this clearance should be determine if it falls within the NESC guidelines.

Span Requirements: The span of 135' will allow a vertical mid span clearance of 30" between the conductor in the Secondary position (#1/0 Triplex) and the Communication's cable "In-Line-of-Site" on adjoining structures. Spans can be increased by either installing a higher pole, raise the secondary bracket to the Minimum Dimensions as indicated in the construction drawing (9-411A), requests the communication company to lower their cable, or have Communication Company agree to sag their cable following the sag of the conductor in the secondary position maintaining 30" mid span clearance. .

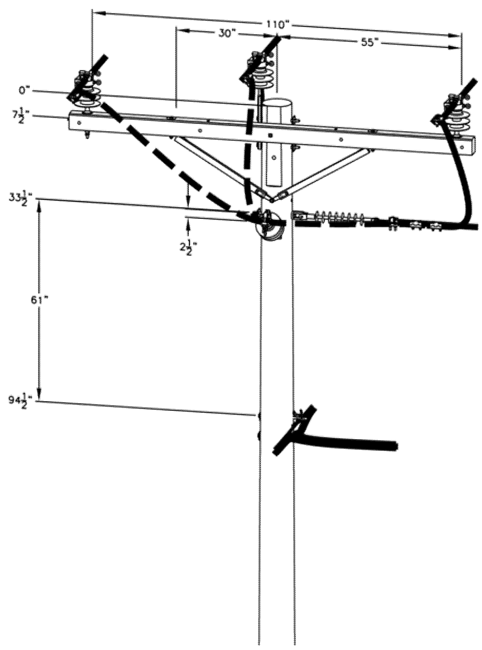
Ice Loaded Conditions: Sag information for Conductors in the Secondary Position should be shared with the various Communication Companies to assist them in evaluating their cable sag requirements to meet NESC codes. Both Electric and Communication companies are allocated their attachment space on poles; however, a mid span clearance of 30" must be maintained when ice loading conditions occur (See Section 7).

Maximum spans are also contingent upon pole loading and crossarm/pin/insulator strengths. See Section 2.

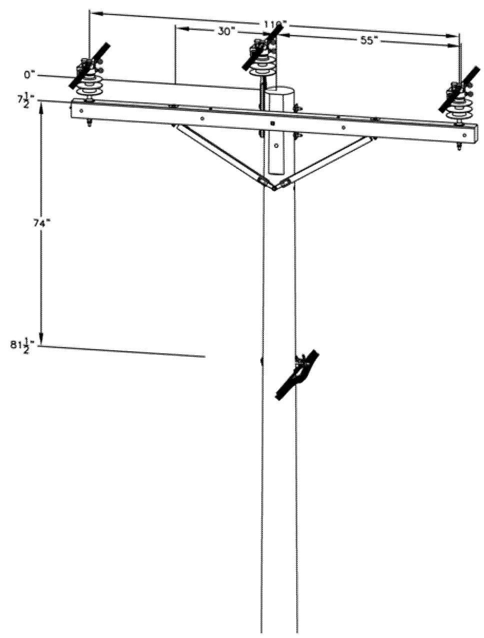
RESERVED FOR FUTURE PUBLICATION



10'– ALLEY ARM (TC10)
(DWG. 20–437)



10'– DOUBLE CROSSARM (TC10)
DEADEND WITH TAP
(DWG. 20–419F1)



10'– CROSSARM (TC10)
TANGENT
(DWG. 20–411)

Supersedes 7/18 Issue – Converted to 3D and added vise top insulators.

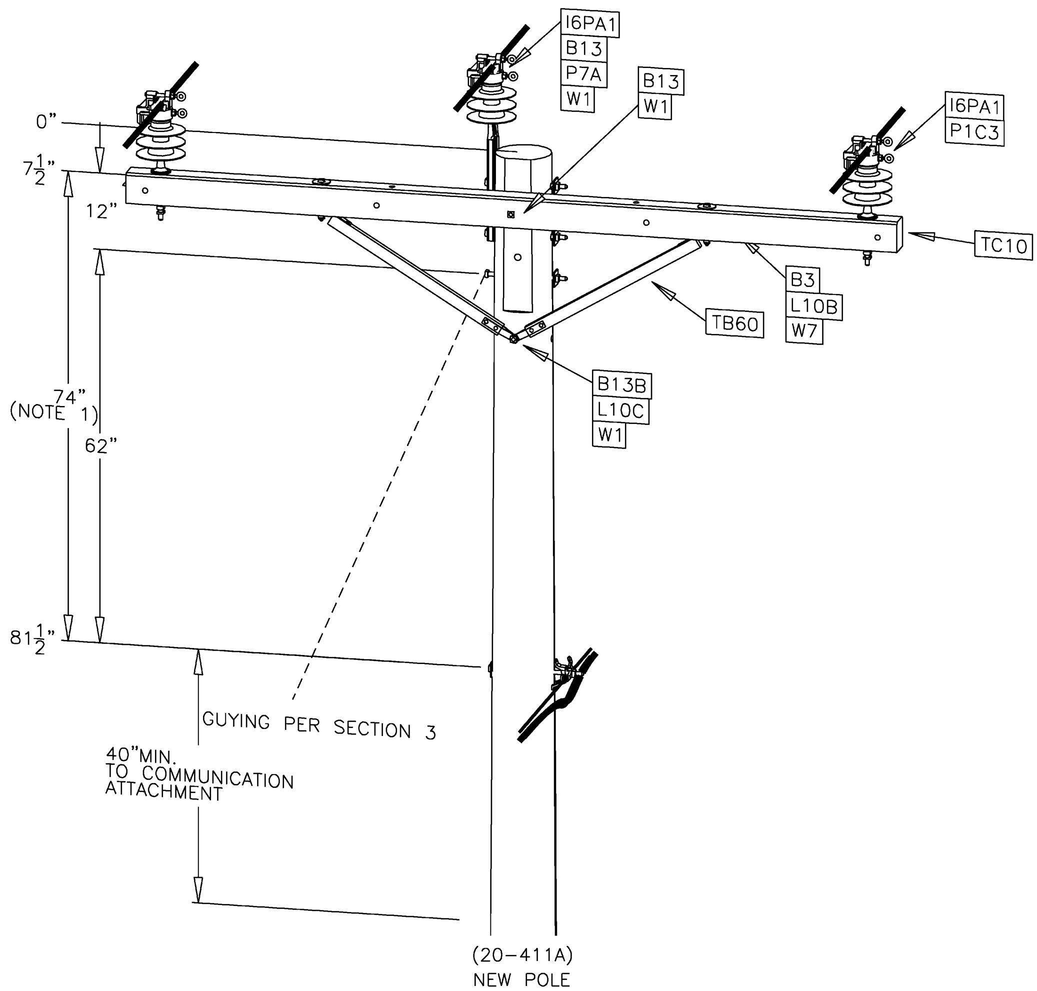
NOTE:
–THESE DIMENSIONS ARE SHOWN AS GENERAL INFORMATION FOR STANDARD POLE TOPS USING STANDARD MATERIALS. REFER TO SECTION 20 PRIMARY DRAWINGS FOR OTHER ARRANGEMENTS.

Designer	Drawing	Date
MPR	od20206	2/15/19

SPACING
25-35 kV DISTRIBUTION PRIMARY

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	20-206	7/19

MU = @20-411A	25-35KV 3Φ - Bare	MU = @20-411ACL	25-35KV 3Φ - Covered
MU = @20-411B	25-35KV 1Φ - Bare	MU = @20-411BCL	25-35KV 1Φ - Covered



Supersedes 7/07 Issue – Converted to 3D and added vise top insulator.

NOTE 1

MINIMUM DIMENSIONS (FOR EXISTING INSTALLATIONS ONLY)	
600V SECONDARY -35KV	53"
NEUTRAL ONLY - 35 KV OPERATION	28"

(20-411B)
- OMIT CENTER CONDUCTOR AND ATTACHMENTS.
- SEE SECTION INDEX FOR STANDARD POLE TOP CONSTRUCTION SELECTION.
- DOUBLE CROSSARMS OR EQUVALENT ARE REQUIRED (NESC 261.D.5.C.) AT EACH CROSSING STRUCTURE, LINES OVER RAILWAYS, LIMITED ACCESS HIGHWAYS, OR NAVIGABLE WATERWAYS REQUIRING CROSSING PERMITS (NESC 241C), AND DEADEND OR ANGLES OVER 20 DEGREES.
- WHERE SEVERE ENVIROMENTAL CONTAMINATION EXISTS, LINE POST INSULATORS (I13D), ¾" STUDS (P1G), AND POLE TOP PINS (P12B) SHOULD BE USED.

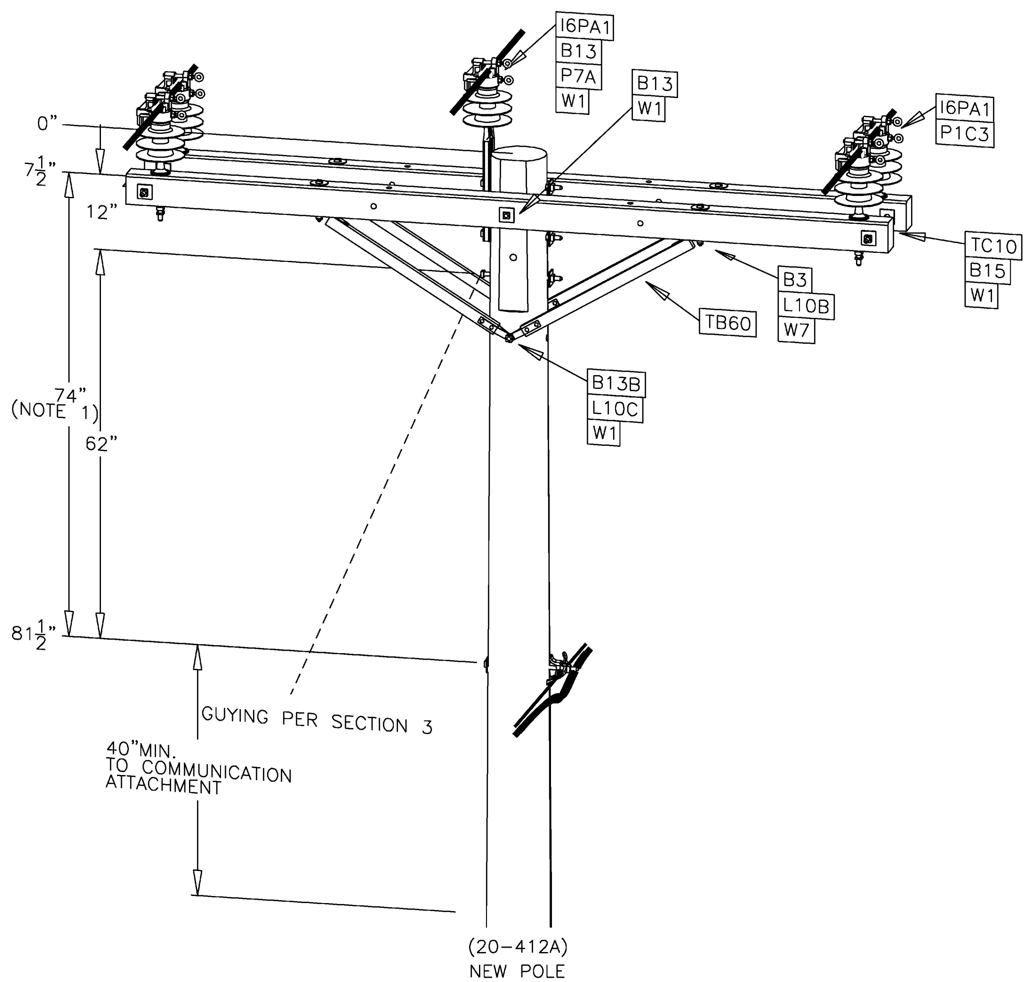
SEE 20-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS			
SPANS WITH 1/0 TRIPLEX SEC			
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE 1/0 AAAC	MAIN LINE 477 AAC
81.5	40 JT-84"	135	135
81.5	45 JT-111"	220	220
SPANS WITH 1/0 AAAC NEUTRAL			
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE 1/0 AAAC	MAIN LINE 477 AAC
81.5	40 JT-84"	225	180
81.5	45 JT-111"	300	--
103	45 JT-111"	--	225
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE			

Designer	Drawing	Date
MPR	od20411	3/15/19

1Φ AND 3Φ CROSSARM POLE TOP – 25-35 kV
0° - 10°

ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD
7/19	20-411	

MU = @20-412A	25-35KV 3Φ - Bare	MU = @20-412ACL	25-35KV 3Φ - Covered
MU = @20-412B	25-35KV 1Φ - Bare	MU = @20-412BCL	25-35KV 1Φ - Covered



Supersedes 7/07 Issue – Converted to 3D and added vise top insulator.

NOTE 1

MINIMUM DIMENSIONS (FOR EXISTING INSTALLATIONS ONLY)	
600V SECONDARY –35KV	53”
NEUTRAL ONLY – 35 KV OPERATION	28”

(20–412B)
– OMIT CENTER CONDUCTOR AND ATTACHMENTS.
– SEE SECTION INDEX FOR STANDARD POLE TOP CONSTRUCTION SELECTION.
– DOUBLE CROSSARMS OR EQUIVALENT ARE REQUIRED (NESC 261.D.5.C.) AT EACH CROSSING STRUCTURE, LINES OVER RAILWAYS, LIMITED ACCESS HIGHWAYS, OR NAVIGABLE WATERWAYS REQUIRING CROSSING PERMITS (NESC 241C), AND DEADEND OR ANGLES OVER 20 DEGREES.
– WHERE SEVERE ENVIROMENTAL CONTAMINATION EXISTS, LINE POST INSULATORS (I13D), ¾” STUDS (P1G), AND POLE TOP PINS (P12B) SHOULD BE USED.

SEE 20–200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS

SPANS WITH 1/0 TRIPLEX SEC			
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE	
		1/0 AAAC	477 AAC
81.5	40 JT–84”	135	135
81.5	45 JT–111”	220	220

SPANS WITH 1/0 AAAC NEUTRAL			
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE	
		1/0 AAAC	477 AAC
81.5	40 JT–84”	225	180
81.5	45 JT–111”	300	––
103	45 JT–111”	––	225

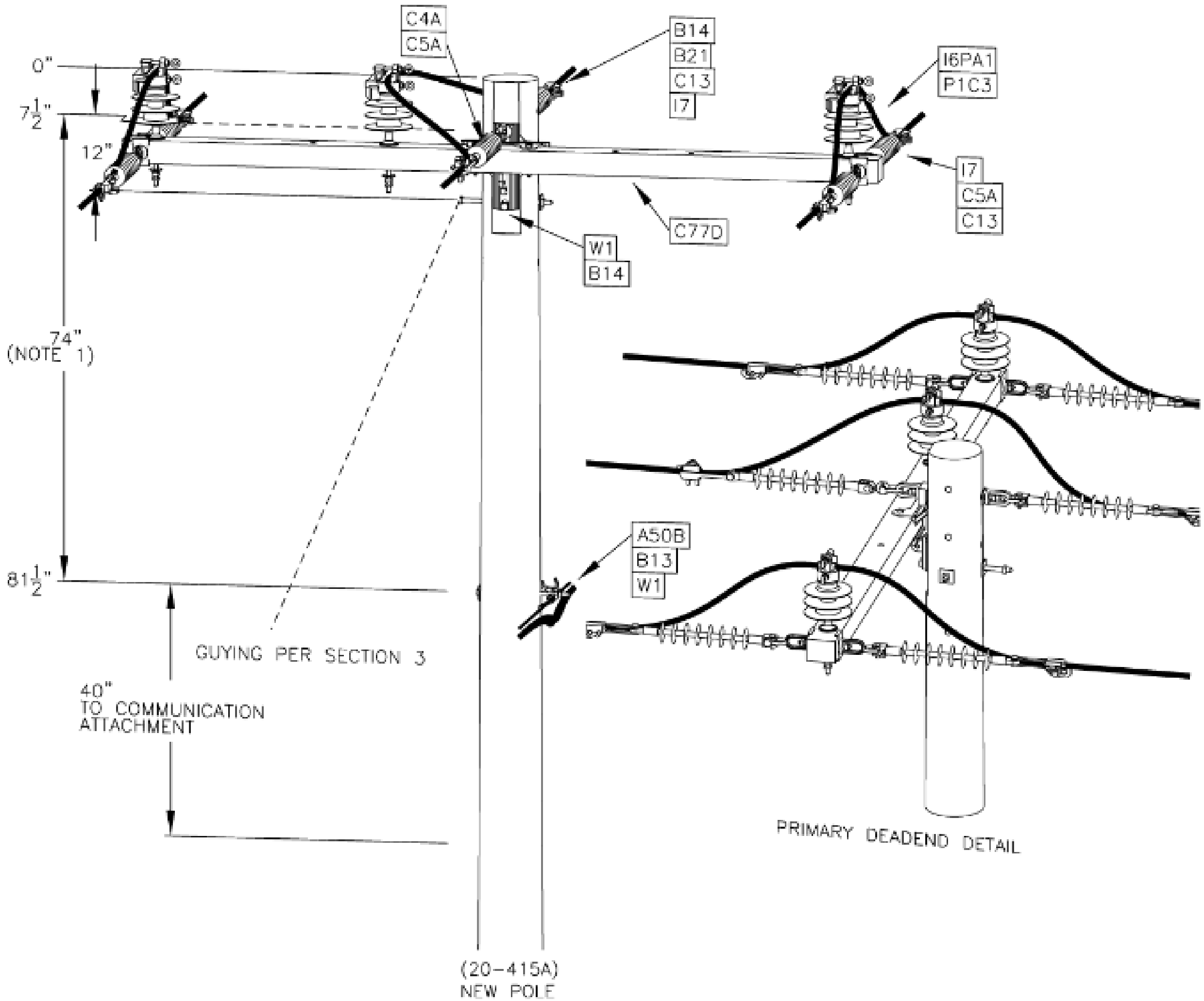
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE

Designer	Drawing	Date
MPR	od20412	3/15/19

1Φ AND 3Φ DOUBLE CROSSARM POLE TOP – 25-35 kV
11° - 20°

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	20-412	7/19

MU = @20-415A	25-35KV 3Φ - Bare	MU = @20-415ACL	25-35KV 3Φ - Covered
MU = @20-415B	25-35KV 1Φ - Bare	MU = @20-415BCL	25-35KV 1Φ - Covered



Supersedes 7/19 Issue – Converted material IDs.

NOTE 1

MINIMUM DIMENSIONS (FOR EXISTING INSTALLATIONS ONLY)	
5KV OPERATION	20"
NEUTRAL ONLY-15KV OPERATION	20"
600V SECONDARY-15KV	48"

(20-415B)

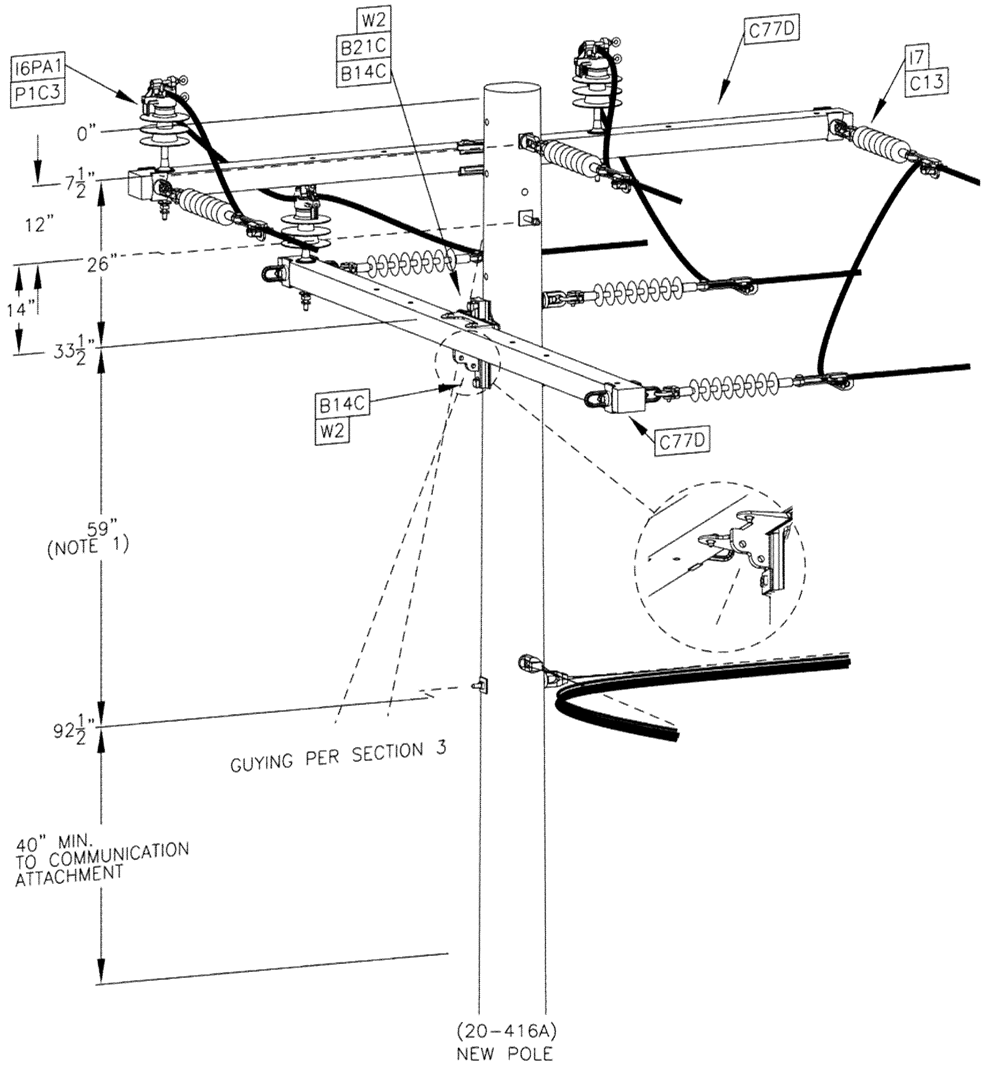
- OMIT CENTER CONDUCTOR AND ATTACHMENTS.
- SEE SECTION INDEX FOR STANDARD POLE TOP CONSTRUCTION SELECTION.
- DOUBLE CROSSARMS OR EQUVALENT ARE REQUIRED (NESC 261.D.5.C.) AT EACH CROSSING STRUCTURE, LINES OVER RAILWAYS, LIMITED ACCESS HIGHWAYS, OR NAVICABLE WATERWAYS REQUIRING CROSSING PERMITS (NESC 241C), AND DEADEND OR ANGLES OVER 20 DEGREES.
- WHERE SEVERE ENVIROMENTAL CONTAMINATION EXISTS, LINE POST INSULATORS (I13D), ¾" STUDS (P1G), AND POLE TOP PINS (P12B) SHOULD BE USED.

SEE 20-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	45 JT-111"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	45 JT-111"	255	185	175
86	45 JT-111"	300	--	--
106	45 JT-111"	--	240	--
107	45 JT-111"	--	--	225
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

Designer	Drawing	Date
MPR	od20415	11/30/20

1Φ AND 3Φ FIBERGLASS CROSSARM POLE TOP – 25-35 kV 21° - 60°

MU = @20-416A	25-35KV 3Φ - Bare	MU = @20-416ACL	25-35KV 3Φ - Covered
MU = @20-416B	25-35KV 1Φ - Bare	MU = @20-416BCL	25-35KV 1Φ - Covered



Supersedes 7/18 Issue – Converted to 3D and added vise top insulator.

NOTE 1

MINIMUM DIMENSIONS (FOR EXISTING INSTALLATIONS ONLY)	
5KV OPERATION	20"
NEUTRAL ONLY-15KV OPERATION	20"
600V SECONDARY-15KV	48"

(20-416B)

- OMIT CENTER CONDUCTOR AND ATTACHMENTS.
- SEE SECTION INDEX FOR STANDARD POLE TOP CONSTRUCTION SELECTION.
- DOUBLE CROSSARMS OR EQUVALENT ARE REQUIRED (NESC 261.D.5.C.) AT EACH CROSSING STRUCTURE, LINES OVER RAILWAYS, LIMITED ACCESS HIGHWAYS, OR NAVIGABLE WATERWAYS REQUIRING CROSSING PERMITS (NESC 241C), AND DEADEND OR ANGLES OVER 20 DEGREES.
- WHERE SEVERE ENVIROMENTAL CONTAMINATION EXISTS, LINE POST INSULATORS (I13D), ¾" STUDS (P1G), AND POLE TOP PINS (P12B) SHOULD BE USED.

SEE 20-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS

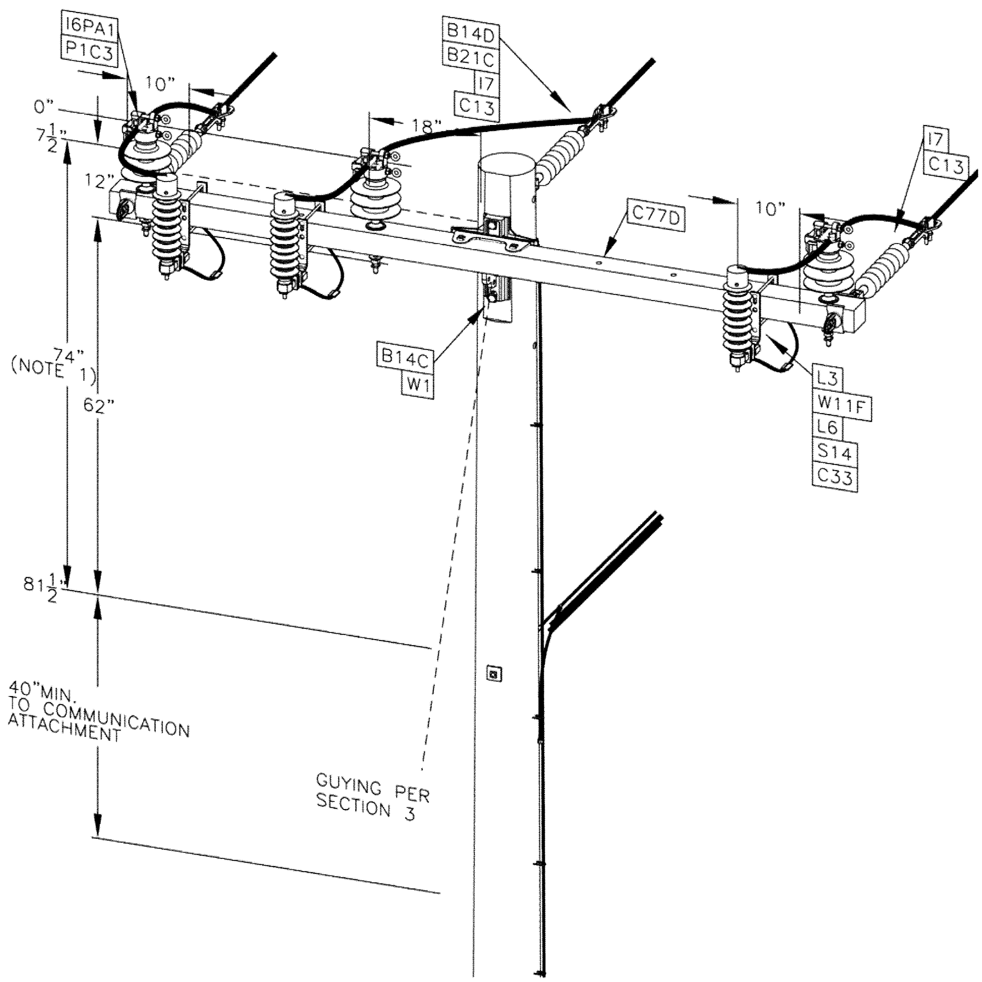
SPANS WITH 1/0 TRIPLEX SEC		MAIN LINE		
SEC BRKT ATTACHMENT	POLE SIZE	1/0 AAAC	336.4 AAC	477 AAC
92.5	45 JT-111"	185	--	--
92.5	45 JT-111"	--	185	--
97.5	45 JT-111"	--	--	180
SPANS WITH 1/0 AAAC NEUTRAL		**MAIN LINE**		
SEC BRKT ATTACHMENT	POLE SIZE	1/0 AAAC	336.4 AAC	477 AAC
103.5	45 JT-111"	255	--	--
108.5	45 JT-111"	--	185	--
108.5	45 JT-111"	--	--	175

THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE

Designer	Drawing	Date
MPR	od20416	3/15/19

1Φ AND 3Φ CROSSARM POLE TOP – 25-35 kV
ANGLES 61° - 90° AND DEADENDS

MU = @20-417A	25-35KV 3Φ - Bare	MU = @20-417ACL	25-35KV 3Φ - Covered
MU = @20-417B	25-35KV 1Φ - Bare	MU = @20-417BCL	25-35KV 1Φ - Covered



(20-417A)
NEW POLE

Supersedes 7/18 Issue – Converted to3D and added vise top insulator.

NOTE 1

MINIMUM DIMENSIONS (FOR EXISTING INSTALLATIONS ONLY)	
5KV OPERATION	20"
NEUTRAL ONLY-15KV OPERATION	20"
600V SECONDARY-15KV	48"

(20-417B)

- OMIT CENTER CONDUCTOR AND ATTACHMENTS.
- SEE SECTION INDEX FOR STANDARD POLE TOP CONSTRUCTION SELECTION.
- DOUBLE CROSSARMS OR EQUIVALENT ARE REQUIRED (NESC 261.D.5.C.) AT EACH CROSSING STRUCTURE, LINES OVER RAILWAYS, LIMITED ACCESS HIGHWAYS, OR NAVIGABLE WATERWAYS REQUIRING CROSSING PERMITS (NESC 241C), AND DEADEND OR ANGLES OVER 20 DEGREES.
- WHERE SEVERE ENVIROMENTAL CONTAMINATION EXISTS, LINE POST INSULATORS (I13D), ¾" STUDS (P1G), AND POLE TOP PINS (P12B) SHOULD BE USED.

SEE 20-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	135	135	135
81.5	45 JT-111"	220	220	220
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		
		1/0 AAAC	336.4 AAC	477 AAC
81.5	40 JT-84"	225	185	175
86	45 JT-111"	300	--	--
106	45 JT-111"	--	240	--
107	45 JT-111"	--	--	225
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

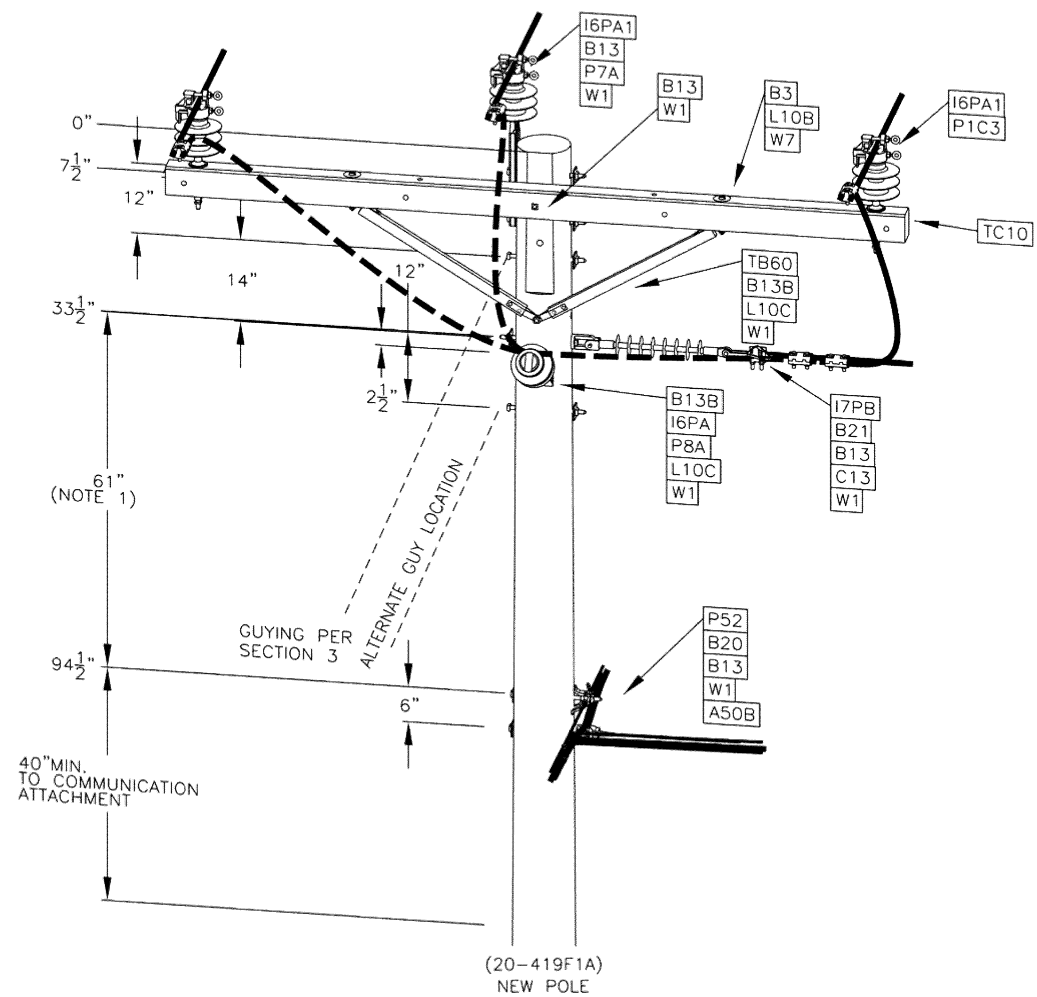
Designer	Drawing	Date
MPR	od20417	3/15/19

1Φ AND 3Φ CROSSARM POLE TOP – 25-35 kV DEADEND			
ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/19	20-417		

Business Use

MU = @20-419F1A	25-35KV 3Φ - Bare	MU = @20-419F1ACL	25-35KV 3Φ - Covered
MU = @20-419F1B	25-35KV 1Φ - Bare	MU = @20-419F1BCL	25-35KV 1Φ - Covered

Supersedes 7/07 Issue – Converted to3D and added vise top insulator.



NOTE 1

MINIMUM DIMENSIONS	
600V SECONDARY-35KV NEUTRAL ONLY OPERATION	50" 28"

(20-419F1B)

- OMIT CENTER CONDUCTOR AND ATTACHMENTS.
- SEE SECTION INDEX FOR STANDARD POLE TOP CONSTRUCTION SELECTION.
- DOUBLE CROSSARMS OR EQUVALENT ARE REQUIRED (NESC 261.D.5.C.) AT EACH CROSSING STRUCTURE, LINES OVER RAILWAYS, LIMITED ACCESS HIGHWAYS, OR NAVIGABLE WATERWAYS REQUIRING CROSSING PERMITS (NESC 241C), AND DEADEND OR ANGLES OVER 20 DEGREES.
- WHERE SEVERE ENVIROMENTAL CONTAMINATION EXISTS, LINE POST INSULATORS (I13D), ¾" STUDS (P1G), AND POLE TOP PINS (P12B) SHOULD BE USED.
- SECONDARY DEADEND BRACKET MAY BE RELOCATED 4" MINIMUM ABOVE OR BELOW EXISTING SECONDARY THRU BRACKET ON EXISTING CONSTRUCTION PROVIDING CLEARANCES CAN BE MAINTAINED. (2.3)
- INSTALL SURGE ARRESTER PER SECTION 13.

SEE 20-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS				
SPANS WITH 1/0 TRIPLEX SEC				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		TAP
		1/0 AAAC	477 AAC	1/0 AAAC
94.5	45 JT-111"	177	177	177
SPANS WITH 1/0 AAAC NEUTRAL				
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE		TAP
		1/0 AAAC	477 AAC	1/0 AAAC
94.5	45 JT-111"	300	--	--
107	45 JT-111"	--	230	--
94.5	45 JT-111"	--	--	184
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

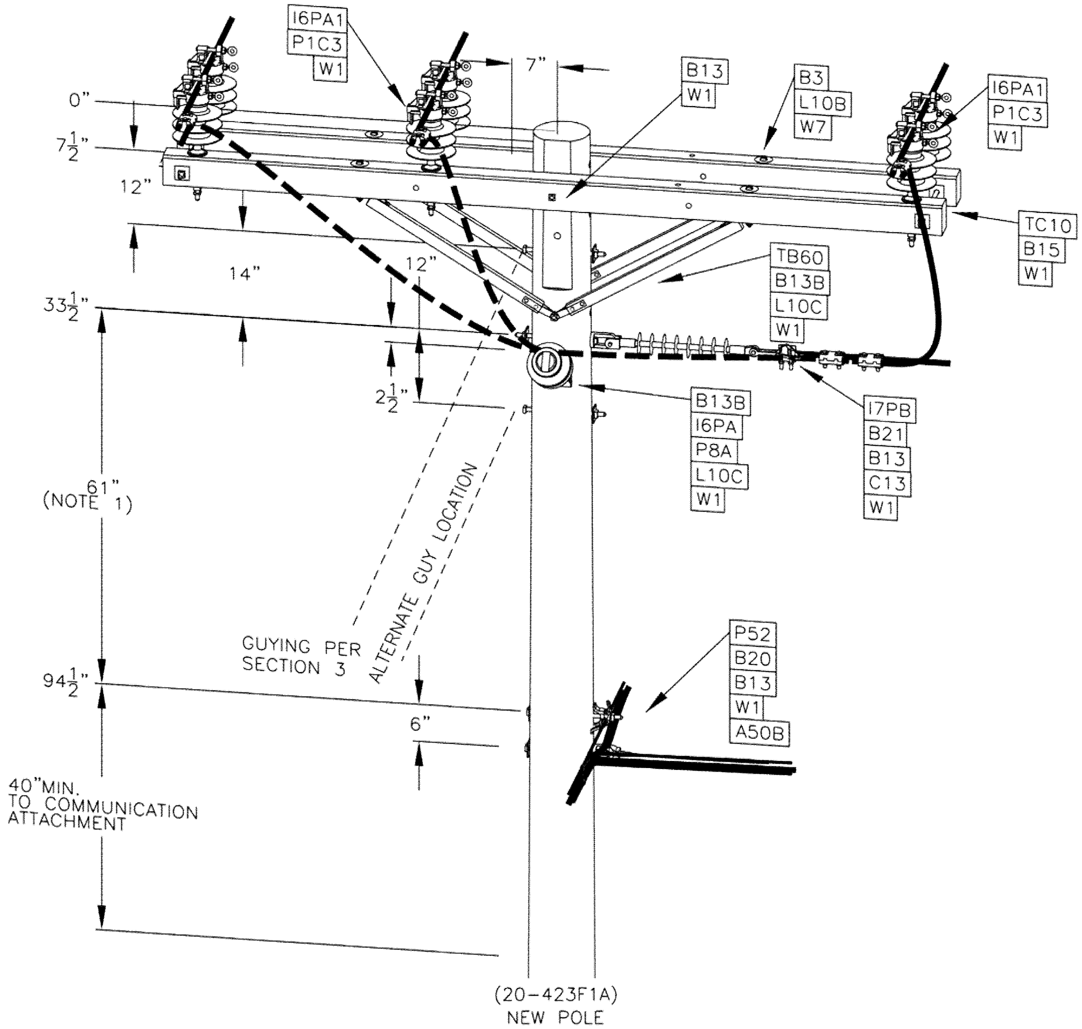
Designer	Drawing	Date
MPR	od20419F1	3/15/19

1Φ AND 3Φ CROSSARM POLE TOP – 25-35 kV
0° - 10 ° – TAP TO 1Φ ARMLESS

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	20-419F1	7/19

MU = @20-423F1A	25-35KV 3Φ - B	MU = @20-423F1ACL	25-35KV 3Φ - Covered
MU = @20-423F1B	25-35KV 1Φ - B	MU = @20-423F1BCL	25-35KV 1Φ - Covered

Supersedes 7/07 Issue – Converted to3D and added vise top insulator.



NOTE 1

MINIMUM DIMENSIONS (FOR EXISTING INSTALLATIONS ONLY)	
600V SECONDARY-35KV	50"
NEUTRAL ONLY OPERATION	28"

(20-423F1B)

- OMIT CENTER CONDUCTOR AND ATTACHMENTS.
- SEE SECTION INDEX FOR STANDARD POLE TOP CONSTRUCTION SELECTION.
- DOUBLE CROSSARMS OR EQUIVALENT ARE REQUIRED (NESC 261.D.5.C.) AT EACH CROSSING STRUCTURE, LINES OVER RAILWAYS, LIMITED ACCESS HIGHWAYS, OR NAVIGABLE WATERWAYS REQUIRING CROSSING PERMITS (NESC 241C), AND DEADEND OR ANGLES OVER 20 DEGREES.
- SECONDARY DEADEND BRACKET MAY BE RELOCATED 4" MINIMUM ABOVE OR BELOW EXISTING SECONDARY THRU BRACKET ON EXISTING CONSTRUCTION PROVIDING CLEARANCES CAN BE MAINTAINED. (2.3)
- INSTALL SURGE ARRESTER PER SECTION 13.
- WHERE SEVERE ENVIROMENTAL CONTAMINATION EXISTS, LINE POST INSULATORS (I13D), ¾" STUDS (P1G), AND POLE TOP PINS (P12B) SHOULD BE USED.

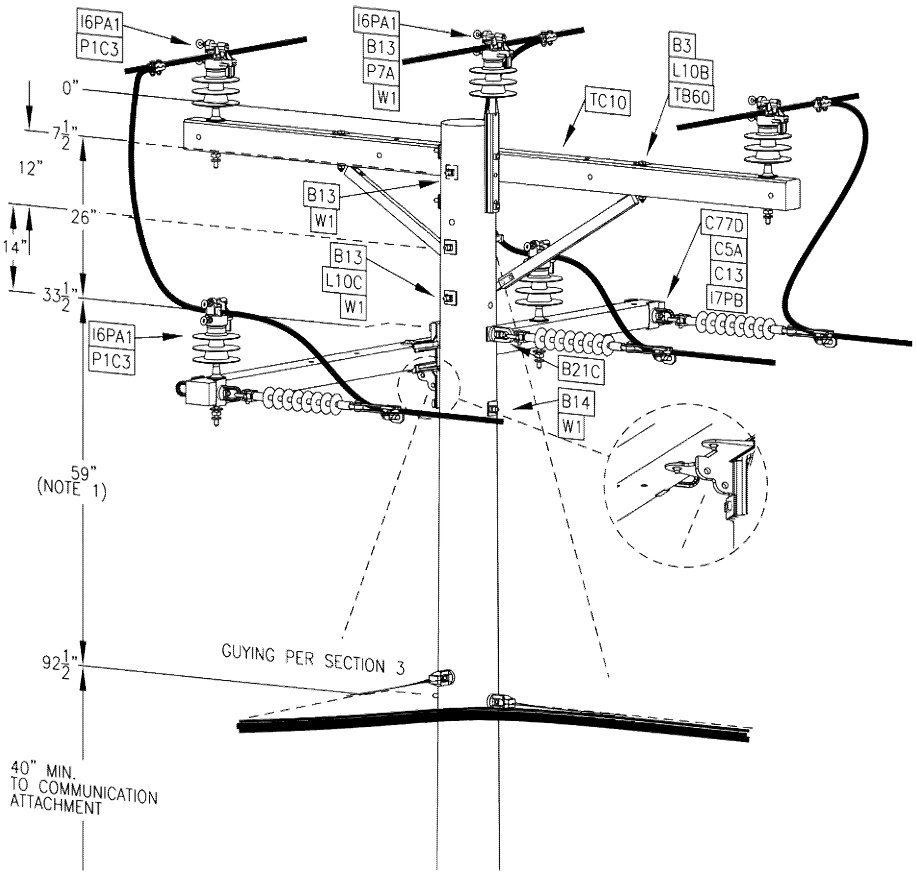
SEE 20-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS

SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE 1/0 AAAC	MAIN LINE 477 AAC	TAP 1/0 AAAC
SPANS WITH 1/0 TRIPLEX SEC				
94.5	45 JT-111"	177	177	177
SPANS WITH 1/0 AAAC NEUTRAL				
94.5	45 JT-111"	300	--	--
107	45 JT-111"	--	230	--
94.5	45 JT-111"	--	--	184
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

Designer	Drawing	Date
MPR	od20423F1	3/15/19

1Φ AND 3Φ DOUBLE CROSSARM POLE TOP – 0-35 kV TAP TO 1Φ ARMLESS			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 20-423F1	ISSUE 7/19

MU = @20-435A	25-35KV 3Φ - Bare	MU = @20-435ACL	25-35KV 3Φ - Covered
MU = @20-435A(X)	25-35KV 3Φ - Bare, (X) = 11 or 21	MU = @20-435ACL(X)	25-35KV 3Φ - Covered, (X) = 11 or 21
MU = @20-435B	25-35KV 1Φ - Bare	MU = @20-435BCL	25-35KV 1Φ - Covered
MU = @20-435B(X)	25-35KV 1Φ - Bare, (X) = 11 or 21	MU = @20-435BCL(X)	25-35KV 1Φ - Covered, (X) = 11 or 21



(20-435A)
NEW POLE

Supersedes 7/07 Issue – Converted to3D and added vise top insulator.

NOTE 1

MINIMUM DIMENSIONS (FOR EXISTING INSTALLATIONS ONLY)	
600V SECONDARY-35KV NEUTRAL ONLY OPERATION	59" 28"

(20-435B)

- OMIT CENTER CONDUCTOR AND ATTACHMENTS.
- SEE SECTION INDEX FOR STANDARD POLE TOP CONSTRUCTION SELECTION.
- INSTALL SURGE ARRESTERS PER SECTION 13.
- WHERE SEVERE ENVIROMENTAL CONTAMINATION EXISTS, LINE POST INSULATORS (I13D), ¾" STUDS (P1G), AND POLE TOP PINS (P12B) SHOULD BE USED.
- SECONDARY DEADEND BRACKET MAY BE RELOCATED 4" MINIMUM ABOVE OR BELOW EXISTING SECONDARY THRU BRACKET ON EXISTING CONSTRUCTION PROVIDING CLEARANCES CAN BE MAINTAINED. (2.3)

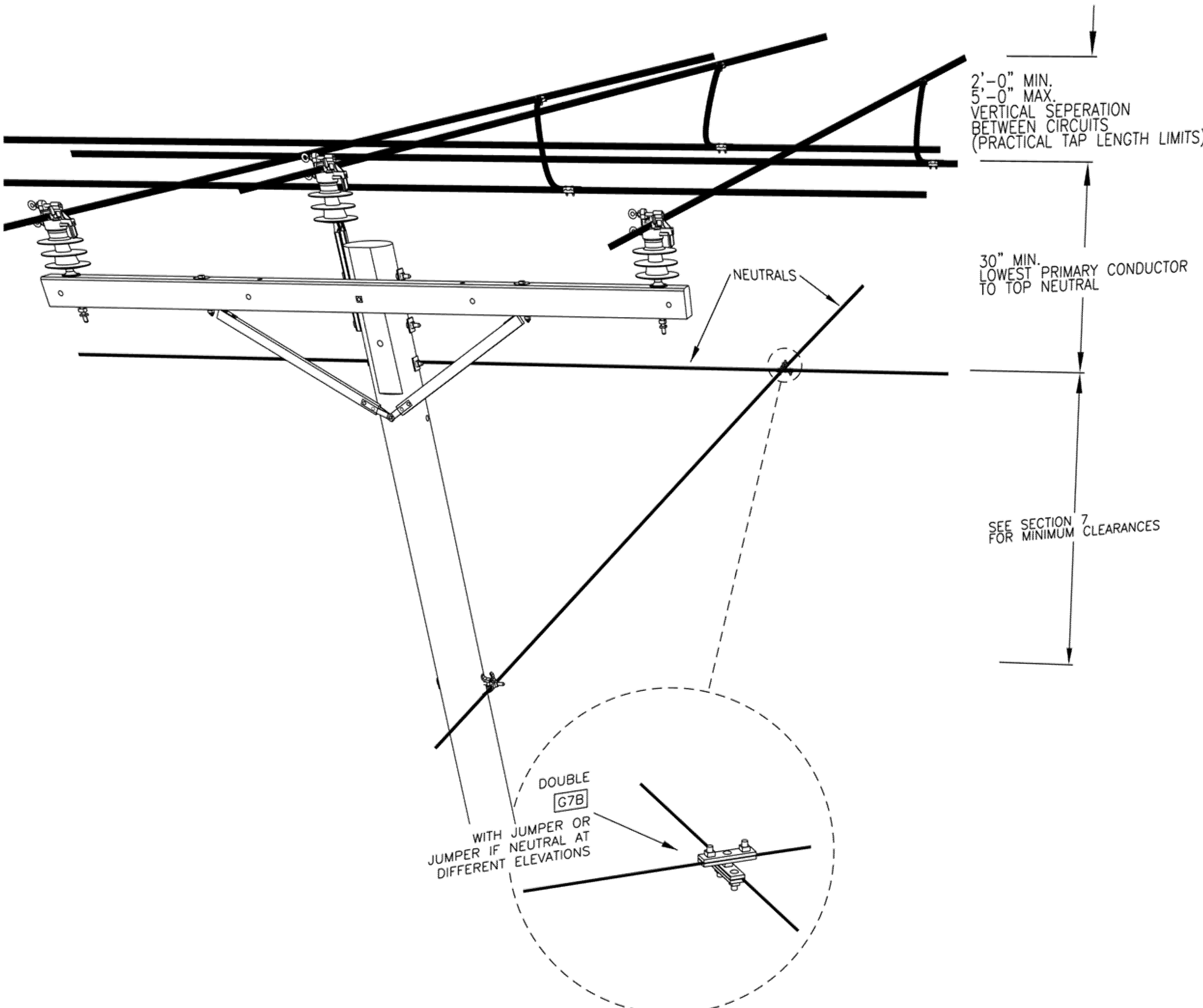
See 20-412 for Tangent Line Angles 11° – 20°.
See 20-415 for Tangent Line Angles 21° – 60°.

SEE 20-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS

SPANS WITH 1/0 TRIPLEX SEC			
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE	
		1/0 AAAC	477 AAC
92.5	45 JT-111"	185	--
98.5	45 JT-111"	--	175
SPANS WITH 1/0 AAAC NEUTRAL			
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE	
		1/0 AAAC	477 AAC
106	45 JT-111"	250	--
109	45 JT-111"	--	160
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE			

Designer	Drawing	Date
MPR	od20435	3/15/19

1Φ AND 3Φ CROSSARM POLE TOP – 25-35 kV –
0° - 10° – TAP TO 1Φ OR 3Φ CROSSARM



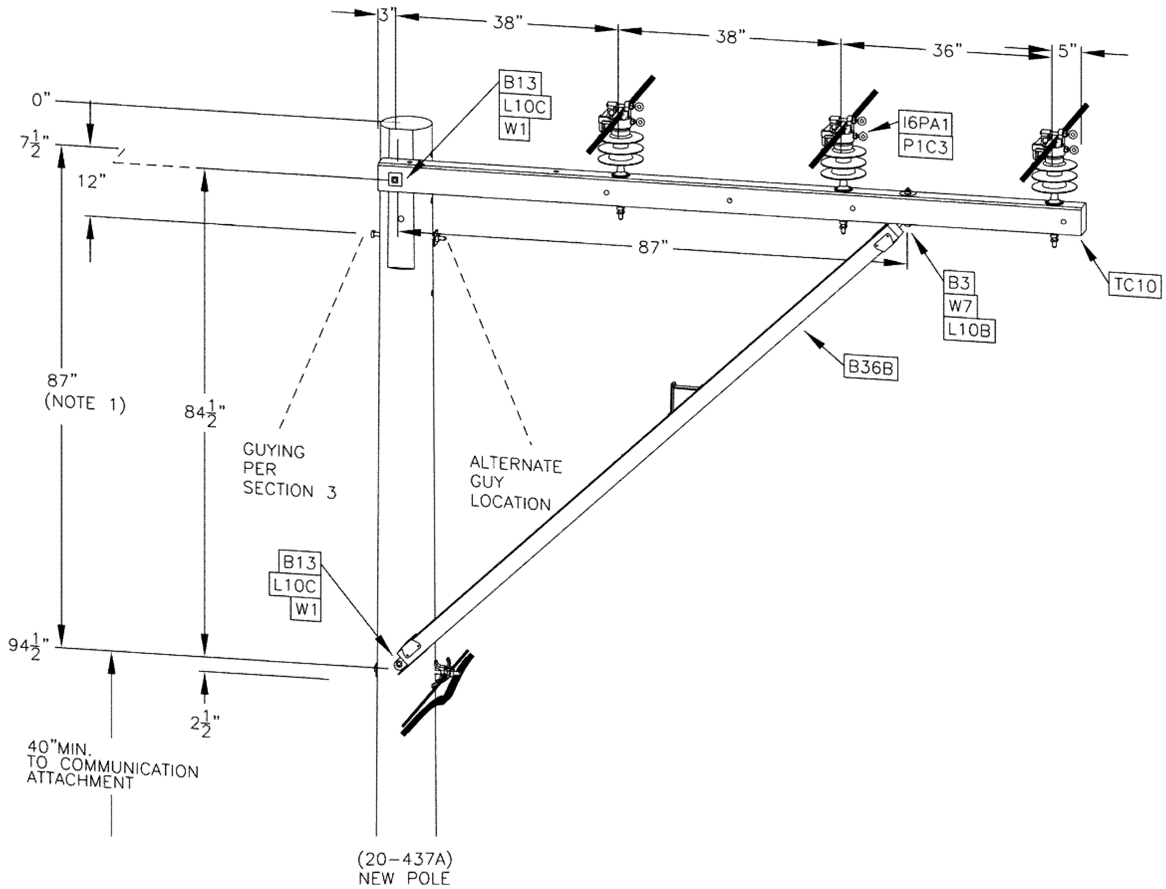
Supersedes 7/07 Issue – Converted to3D and added vise top insulator.

NOTES:

1. MID-SPAN TAPS MAY BE REQUIRED WHERE POLES ARE SET BACK AT HEAVY INTERSECTIONS.
2. SEE DRAWING 20-435 FOR STANDARD 3-PHASE TAP AT THE POLE.
3. SEE DRAWING 20-105 FOR INFORMATION ON RELATIVE PHASE POSITIONING.
4. ALUMINUM OXIDE QUICKLY FORMS ON CLEANED ALUMINUM CONNECTORS AND IS NON-CONDUCTIVE AND NON-VISIBLE. ALWAYS WIRE BRUSH SURFACE OF CONDUCTORS IMMEDIATELY BEFORE MAKING ELECTRICAL CONNECTIONS.
5. SEE SECTION 5 FOR INFORMATION ON CONNECTORS.

Designer	Drawing	Date
MPR	od20436	3/15/19

MU = @20-437A	25-35KV 3Φ - Bare	MU = @20-437ACL	25-35KV 3Φ - Covered
MU = @20-437B	25-35KV 1Φ - Bare	MU = @20-437BCL	25-35KV 1Φ - Covered



Supersedes 7/07 Issue – Converted to3D and added vise top insulator.

NOTE 1

MINIMUM DIMENSIONS (FOR EXISTING INSTALLATIONS ONLY)	
600V SECONDARY-35KV	45"
NEUTRAL ONLY-15KV OPERATION	28"

NOTE: (20-437B)

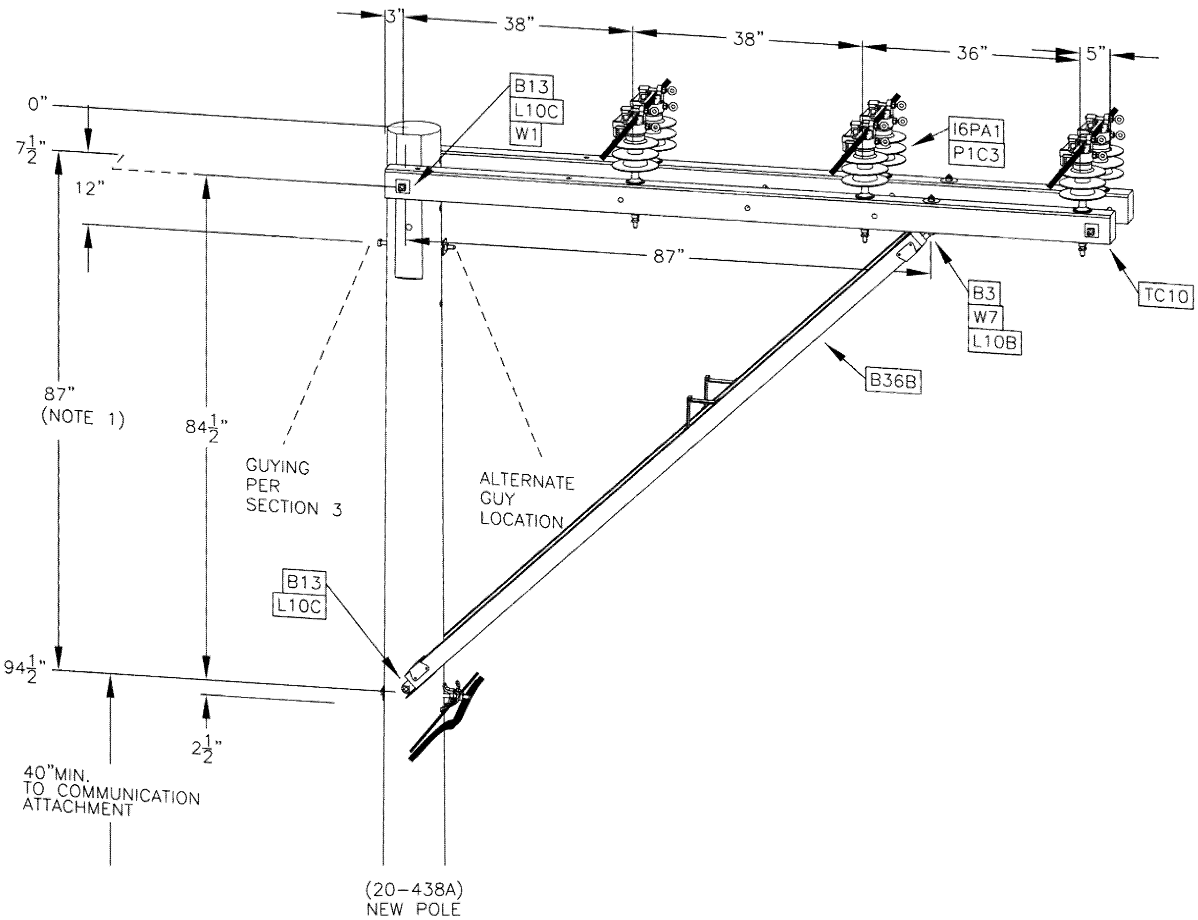
- ALLEY ARM CONSTRUCTION SHALL BE USED ONLY AS REQUIRED FOR LATERAL CLEARANCE TO AVOID RESTRICTED TREE TRIMMING OR TO ELIMINATE SOME OFFSET LINE CONDITIONS.
- OMIT CENTER CONDUCTOR AND ATTACHMENTS.
- SEE SECTION INDEX FOR STANDARD POLE TOP CONSTRUCTION SELECTION.
- USE 2000 LB CONSTRUCTION ONLY.
- TWO OR MORE ADJACENT POLES WITH EXTENSION ARMS SHALL BE USED TO REDUCE THE EXCESSIVE LATERAL STRESS.
- GUYING IS NOT NECESSARY FOR IN LINE POLES WITH OFFSET ARMS UNLESS FORCESS ARE BEING EXERTED PER SECTION 3.
- WHERE SEVERE ENVIROMENTAL ONTAMINATION EXISTS, LINE POST NSULATORS (I13D), ¾" STUDS (P1G), AND POLE TOP PINS (P12B) SHOULD BE USED.

SEE 20-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS			
SPANS WITH 1/0 TRIPLEX SEC			
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE	
		1/0 AAAC	477 AAC
94.5	40 JT-84"	135	135
94.5	45 JT-111"	220	220
SPANS WITH 1/0 AAAC NEUTRAL			
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE	
		1/0 AAAC	477 AAC
94.5	40 JT-84"	225	180
94.5	45 JT-111"	300	--
103	45 JT-111"	--	225
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE			

Designer	Drawing	Date
MPR	od20437	3/15/19

1Φ AND 3Φ SINGLE ALLEY ARM POLE TOP – 25-35 kV – 0° - 10°

MU = @20-438A	25-35KV 3Φ - Bare	MU = @20-438ACL	25-35KV 3Φ - Covered
MU = @20-438B	25-35KV 1Φ - Bare	MU = @20-438BCL	25-35KV 1Φ - Covered



NOTE 1

MINIMUM DIMENSIONS (FOR EXISTING INSTALLATIONS ONLY)	
600V SECONDARY-35KV	45"
NEUTRAL ONLY-15KV OPERATION	28"

(20-438B)

NOTE:
- ALLEY ARM CONSTRUCTION SHALL BE USED ONLY AS REQUIRED FOR LATERAL CLEARANCE TO AVOID RESTRICTED TREE TRIMMING OR TO ELIMINATE SOME OFFSET LINE CONDITIONS.
- OMIT CENTER CONDUCTOR AND ATTACHMENTS.
- SEE SECTION INDEX FOR STANDARD POLE TOP CONSTRUCTION SELECTION.
- USE 2000 LB CONSTRUCTION ONLY.
- TWO OR MORE ADJACENT POLES WITH EXTENSION ARMS SHALL BE USED TO REDUCE THE EXCESSIVE LATERAL STRESS.
- GUYING IS NOT NECESSARY FOR IN LINE POLES WITH OFFSET ARMS UNLESS FORCESS ARE BEING EXERTED PER SECTION 3.
- WHERE SEVERE ENVIROMENTAL CONTAMINATION EXISTS, LINE POST INSULATORS (I13D), ¾" STUDS (P1G), AND POLE TOP PINS (P12B) SHOULD BE USED.

SEE 20-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS			
SPANS WITH 1/0 TRIPLEX SEC			
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE	
		1/0 AAAC	477 AAC
94.5	40 JT-84"	135	135
94.5	45 JT-111"	220	220
SPANS WITH 1/0 AAAC NEUTRAL			
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE	
		1/0 AAAC	477 AAC
94.5	40 JT-84"	225	180
94.5	45 JT-111"	300	--
103	45 JT-111"	--	225
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE			

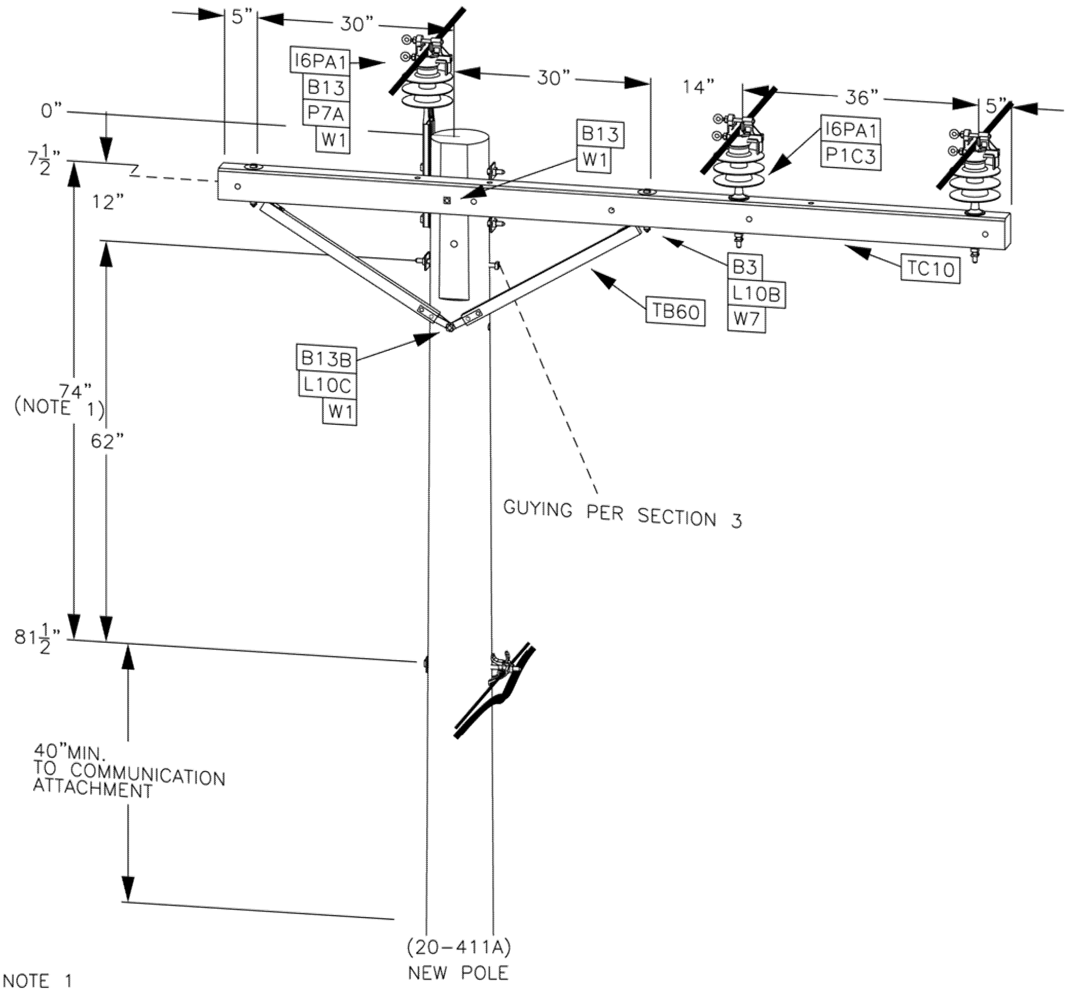
Designer	Drawing	Date
MPR	od20438	3/15/19

Supersedes 7/07 Issue – Converted to3D and added vise top insulator.

1Φ AND 3Φ DOUBLE ALLEY ARM POLE TOP – 25-35 kV – 11° - 20°

ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD
7/19	20-438	

MU = @20-441A	25-35KV 3Φ - Bare	MU = @20-441ACL	25-35KV 3Φ - Covered
MU = @20-441B	25-35KV 1Φ - Bare	MU = @20-441BCL	25-35KV 1Φ - Covered



NOTE 1

MINIMUM DIMENSIONS (FOR EXISTING INSTALLATIONS ONLY)	
600V SECONDARY -35KV	52"
Neutral Only - 35 kV Operation	28"

(20-411B)

NOTE:
- OFFSET CROSSARM CONSTRUCTION SHALL BE USED ONLY AS REQUIRED FOR LATERAL CLEARANCE TO AVOID RESTRICTED TREE TRIMMING OR TO ELIMINATE SOME OFFSET LINE CONDITIONS.
- OMIT CENTER CONDUCTOR AND ATTACHMENTS.
- SEE SECTION INDEX FOR STANDARD POLE TOP CONSTRUCTION SELECTION.
- USE 2000 LB CONSTRUCTION ONLY.
- TWO OR MORE ADJACENT POLES WITH OFFSET ARMS SHALL BE USED TO REDUCE THE EXCESSIVE LATERAL STRESS.
- GUYING IS NOT NECESSARY FOR IN LINE POLES WITH OFFSET ARMS UNLESS FORCESS ARE BEING EXERTED PER SECTION 3.
- WHERE SEVERE ENVIROMENTAL CONTAMINATION EXISTS, LINE POST INSULATORS (I13D), 3#4" STUDS (P1G), AND POLE TOP PINS (P12B) SHOULD BE USED.

SEE 20-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS

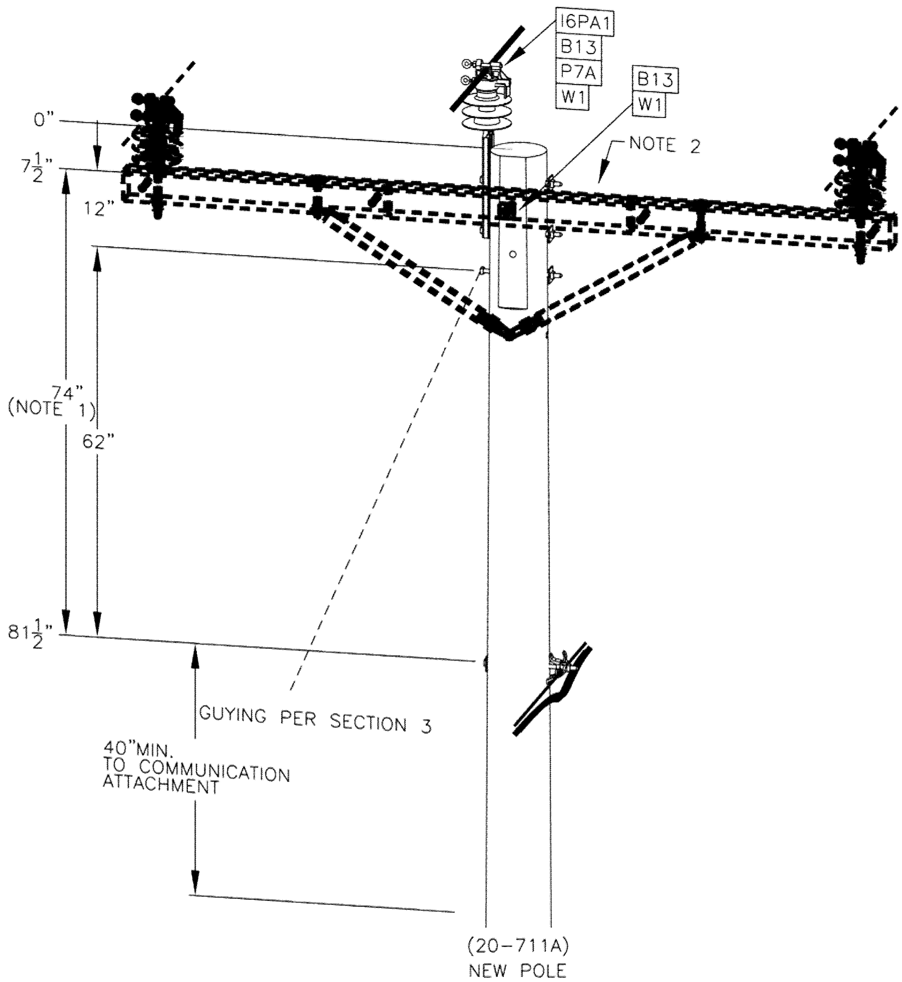
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE 1/0 AAAC	MAIN LINE 477 AAC
SPANS WITH 1/0 TRIPLEX SEC			
81.5	40 JT-84"	135	135
81.5	45 JT-111"	220	220
SPANS WITH 1/0 AAAC NEUTRAL			
81.5	40 JT-84"	225	180
81.5	45 JT-111"	300	--
103	45 JT-111"	--	225
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE			

Designer	Drawing	Date
MPR	od20441	3/15/19

Supersedes 7/07 Issue – Converted to3D and added vise top insulator.

1Φ AND 3Φ SINGLE ALLEY OFFSET POLE TOP – 25-35 kV – 0˚ - 10˚

MU = @20-711		25-35KV 1Φ - Bare	MU = @20-711CL	25-35KV 1Φ - Covered



NOTE 1

MINIMUM DIMENSIONS (FOR EXISTING INSTALLATIONS ONLY)	
600V SECONDARY -35KV	38"
Neutral Only - 35 kV Operation	28"

- SEE SECTION INDEX FOR STANDARD POLE TOP CONSTRUCTION SELECTION.
- WHERE SEVERE ENVIROMENTAL CONTAMINATION EXISTS, LINE POST INSULATORS (I13D), ¾" STUDS (P1G), AND POLE TOP PINS (P12B) SHOULD BE USED.

NOTE 2 - FOR FUTURE 3ø, SEE 20-411

SEE 20-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS			
SPANS WITH 1/0 TRIPLEX SEC			
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE	
		1/0 AAAC	477 AAC
81.5	40 JT-84"	135	135
81.5	45 JT-111"	220	220
SPANS WITH 1/0 AAAC NEUTRAL			
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE	
		1/0 AAAC	477 AAC
81.5	40 JT-84"	225	225
81.5	45 JT-111"	300	--
103	45 JT-111"	--	225
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE			

Designer	Drawing	Date
MPR	od20711	3/15/19

Supersedes 7/07 Issue – Converted to 3D and added vise top insulator.

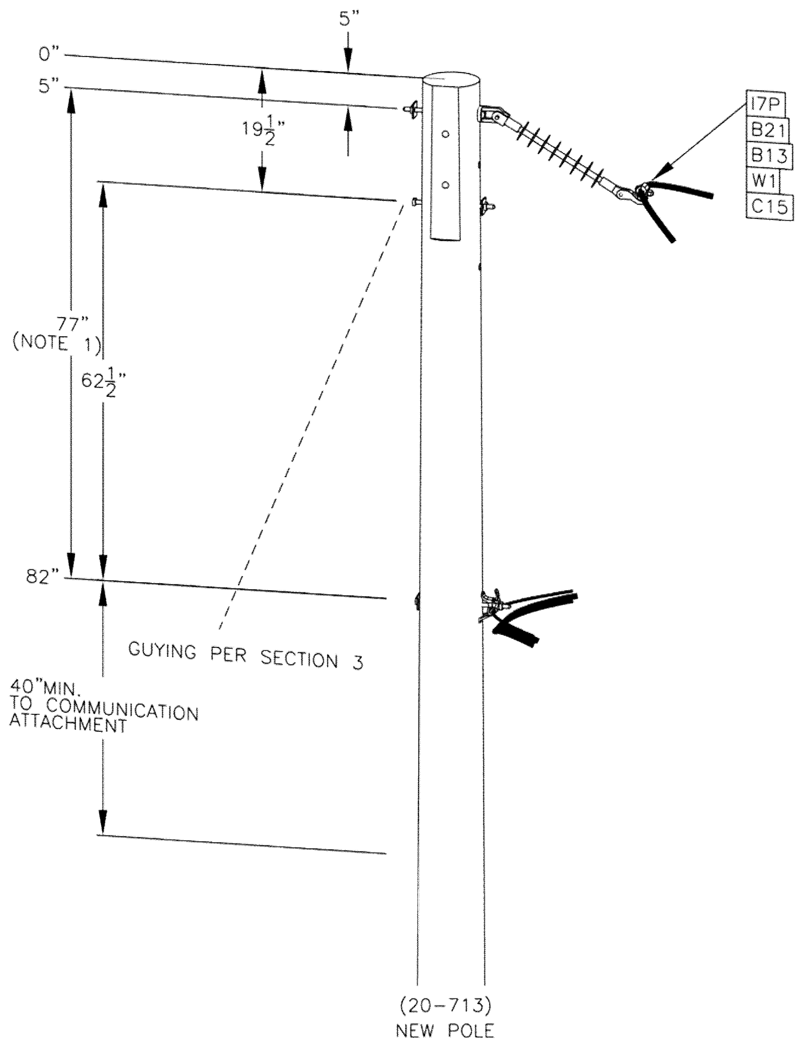
1Φ ARMLESS POLE TOP – 25-35 kV

0˚ - 20˚

ISSUE	PAGE NUMBER		
7/19	20-711	OVERHEAD CONSTRUCTION STANDARD	ppl

MU = @20-713	25-35KV 1Φ - Bare	MU = @20-713CL	25-3KV 1Φ - Covered

Supersedes 7/07 Issue – Converted to 3D and added vise top insulator.



NOTE 1

MINIMUM DIMENSIONS (FOR EXISTING INSTALLATIONS ONLY)	
600V SECONDARY -35KV	48"
Neutral Only - 35 kV Operation	28"

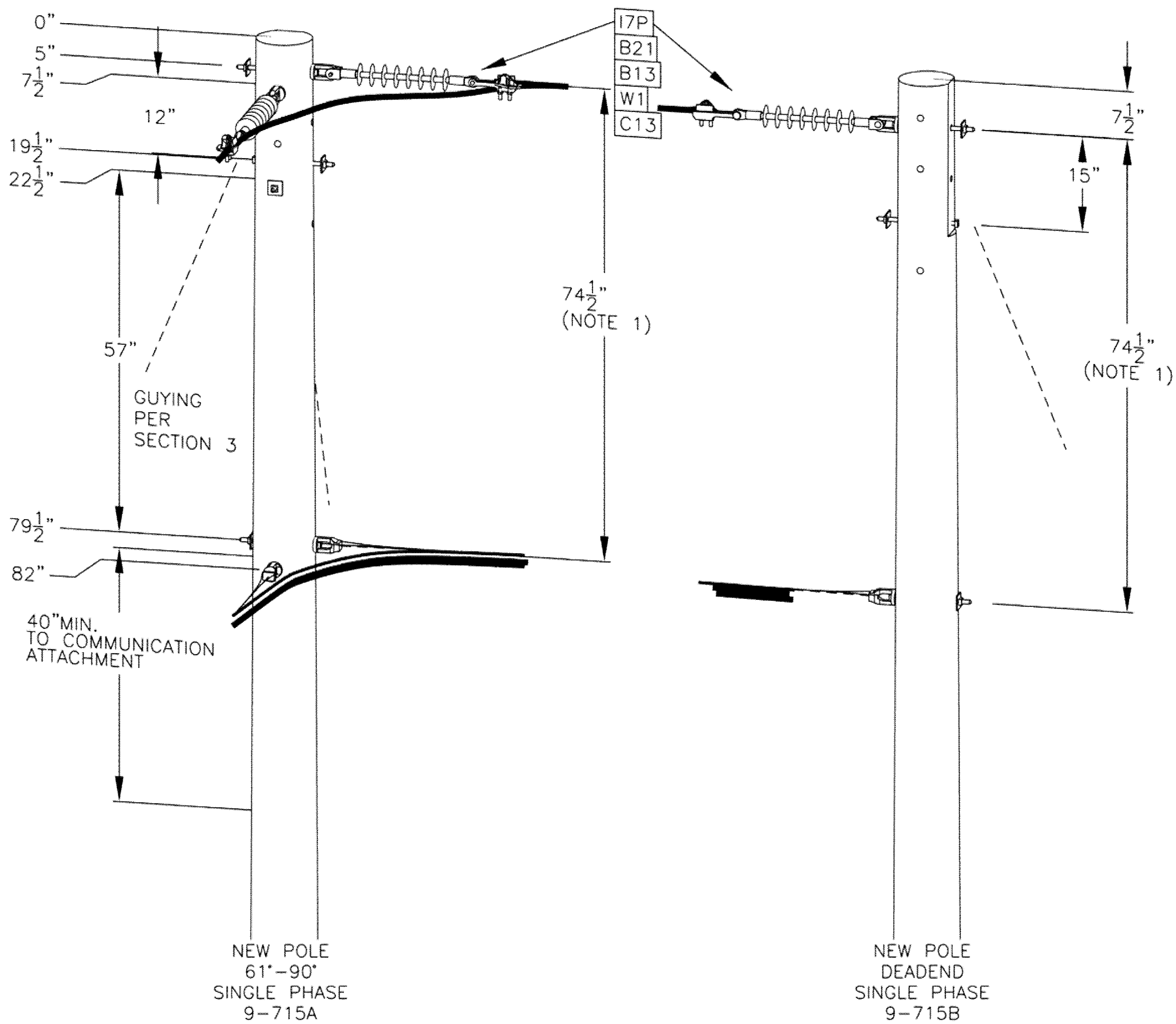
- SEE SECTION INDEX FOR STANDARD POLE TOP CONSTRUCTION SELECTION.
- WHERE SEVERE ENVIROMENTAL CONTAMINATION EXISTS, LINE POST INSULATORS (I13D), ¾" STUDS (P1G), AND POLE TOP PINS (P12B) SHOULD BE USED.

SEE 20-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS			
SPANS WITH 1/0 TRIPLEX SEC			
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE 1/0 AAAC	MAIN LINE 477 AAC
82	40 JT-84"	135	135
82	45 JT-111"	220	220
SPANS WITH 1/0 AAAC NEUTRAL			
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE 1/0 AAAC	MAIN LINE 477 AAC
82	40 JT-84"	225	163
87	45 JT-111"	300	--
103	45 JT-111"	--	225
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE			

Designer	Drawing	Date
MPR	od20713	3/15/19

1Φ ARMLESS POLE TOP – 25-35 kV
21˚ - 60˚

MU = @20-715A	25-35KV 1Φ - Bare	MU = @20-715ACL	25-35KV 1Φ - Covered
MU = @20-715B	25-35KV 1Φ DE - Bare	MU = @20-715BCL	25-35KV 1Φ – DE - Covered



Supersedes 7/07 Issue – Converted to 3D and added vise top insulator.

NOTE 1

MINIMUM DIMENSIONS (FOR EXISTING INSTALLATIONS ONLY)	
600V SECONDARY-35KV	50.5"
NEUTRAL ONLY-35KV OPERATION	28"

- SEE SECTION INDEX FOR STANDARD POLE TOP CONSTRUCTION SELECTION.
- WHERE SEVERE ENVIROMENTAL CONTAMINATION EXISTS, LINE POST INSULATORS (I13D), ¾" STUDS (P1G), AND POLE TOP PINS (P12B) SHOULD BE USED.
- INSTALL SURGE ARRESTER PER SECTION 13.

SEE 20-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS

SPANS WITH 1/0 TRIPLEX SEC			
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE 1/0 AAAC	MAIN LINE 477 AAC
82	40 JT-84"	135	135
82	45 JT-111"	220	214

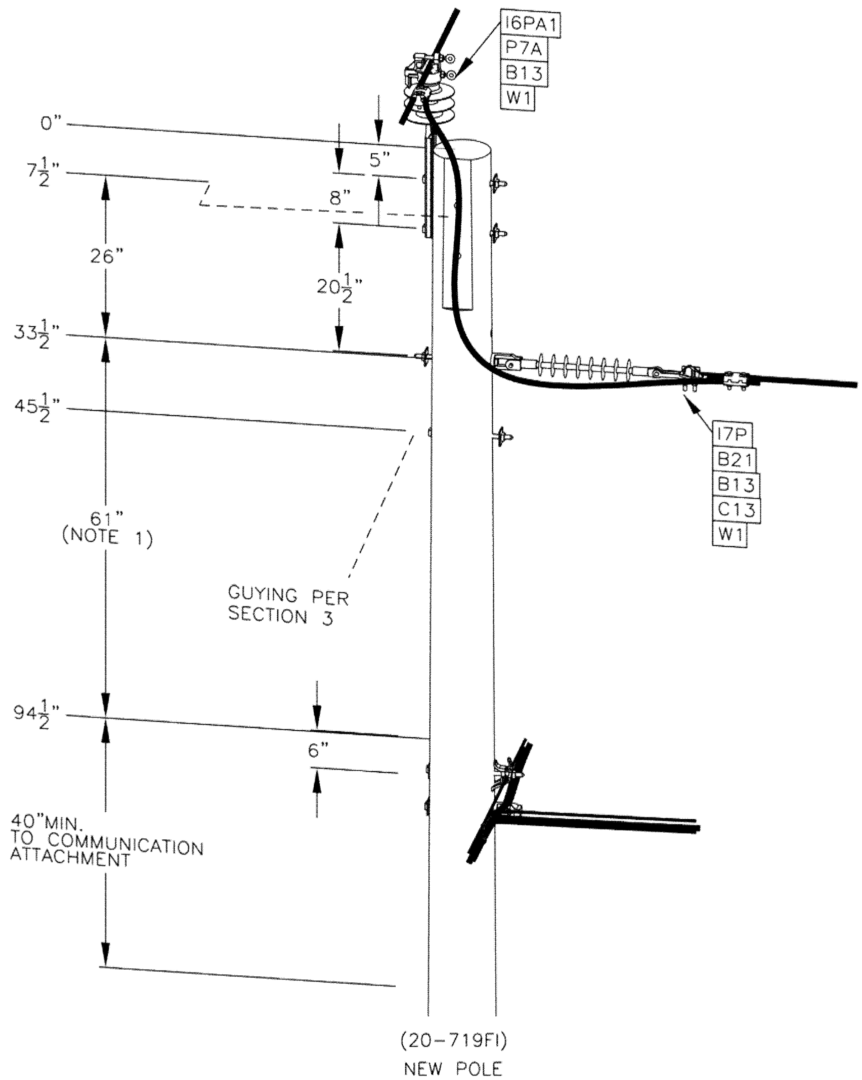
SPANS WITH 1/0 AAAC NEUTRAL			
SEC BRKT ATTACHMENT	POLE SIZE	MAIN LINE 1/0 AAAC	MAIN LINE 477 AAC
82	40 JT-84"	225	160
90	45 JT-111"	300	--
106	45 JT-111"	--	210

THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE

Designer	Drawing	Date
MPR	od20715	3/15/19

1Φ ARMLESS POLE TOP – 25-35 kV
61˚ - 90˚ AND DEADEND

ISSUE	PAGE NUMBER		
7/19	20-715	OVERHEAD CONSTRUCTION STANDARD	ppl



Supersedes 7/07 Issue – Converted to 3D and added vise top insulator.

NOTE 1

MINIMUM DIMENSIONS (FOR EXISTING INSTALLATIONS ONLY)	
600V SECONDARY-35KV	50"
NEUTRAL ONLY-35KV OPERATION	28"

- SEE SECTION INDEX FOR STANDARD POLE TOP CONSTRUCTION SELECTION.
- WHERE SEVERE ENVIROMENTAL CONTAMINATION EXISTS, LINE POST INSULATORS (I13D), ¾" STUDS (P1G), AND POLE TOP PINS (P12B) SHOULD BE USED.
- SECONDARY DEADEND BRACKET MAY BE RELOCATED 4" MINIMUM ABOVE OR BELOW EXISTING ECONDARY THRU BRACKET ON EXISTING CONSTRUCTION PROVIDING CLEARANCES CAN BE AINTAINED. (2.3)
- INSTALL SURGE ARRESTER PER SECTION 13.

SEE 20-200 FOR ADDITIONAL INFORMATION ON MAXIMUM SPANS

SEC BRKT ATTACHMENT	POLE SIZE	1/0 AAAC	MAIN LINE 477 AAC	TAP 1/0 AAAC
SPANS WITH 1/0 TRIPLEX SEC				
94.5	45 JT-111"	177	177	177
SPANS WITH 1/0 AAAC NEUTRAL				
94.5	45 JT-111"	300	207	184
THIS TABLE BASED ON EQUAL OWNERSHIP PERCENTAGE				

Designer	Drawing	Date
MPR	od20719	3/15/19

1 Φ ARMLESS POLE TOP – 25-35kV
0° - 20° – TAP TO 1 Φ ARMLESS

Version	Date	Modification	Author(s)	Approval by (Name/Title)
4	07/21	• Revise material item details in drawing 20-415.		
3	07/19	• Revised drawings 20-115, 206, 411, 412, 415, 416, 417, 419F1, 423F1 435, 436, 437, 438, 441, 711, 713, 715, and 719 to be converted to 3D. • Added drawing 20-116.		
2	07/18	• Revised details on pp 20-115 and 20-206. • Revised drawings 20-415, 416 and 417 to include fiberglass deadend crossarms.		
1	07/15	• Added new section 20.0.10 Scope – Distribution Lines.		

Supersedes 7/19 Issue – Updated title.

Supersedes 7/19 Issue – renumbered

○ 25kV, 35kV, 46kV – Shield Wire, Strain, 11 – 20 Degree Line Angle	21-303
○ 25kV, 35kV, 46kV – Shield Wire, Double Arm, 0 – 2 Degree Line Angle	21-304
○ 25kV, 35kV, 46kV – Shield Wire, Single Pole – Vertical – Single Circuit Tee Tap	21-305
• CONDUCTORS	
○ 1113.0 KCMIL, 54/19 STRANDING, BARE ACSR, "FINCH"	21-401 THRU 21-402
○ 795.0 KCMIL, 54/7 STRANDING, BARE ACSR, "CONDOR"	21-403 THRU 21-404
○ 795.0 KCMIL, 37 STRAND, BARE AAC, "ARBUTUS"	21-405 THRU 21-406
○ 795.0 KCMIL, 37 STRAND, COMPACT AAC, 320 MIL COVERED TREE WIRE – 35 kV	21-407 THRU 21-408
○ 477.0 KCMIL, 26/7 STRANDING, BARE ACSR, "HAWK"	21-409 THRU 21-410
○ 477.0 KCMIL, 19 STRAND, BARE AAC, "COSMOS"	21-411 THRU 21-412
○ 477.0 KCMIL, 19 STRAND, COMPACT AAC, 320 MIL COVERED TREE WIRE – 35 kV	21-413 THRU 21-414
○ 336.4 KCMIL, 18/1 STRANDING, BARE ACSR, "MERLIN"	21-415 THRU 21-416
○ 336.4 KCMIL, 19 STRAND, BARE AAC, "TULIP"	21-417 THRU 21-418
○ 1/0, 7 STRAND, BARE 6201-T81 AAAC, "AZUZA"	21-419 THRU 21-420
○ 1/0, 7 STRAND, CONCENTRIC ROUND 6201-T81 AAAC, ○ 315 MIL COVERED TREE WIRE – 35 kV	21-421 THRU 21-422

Supersedes 7/18 Issue – Added new shield wire drawings 21-304,21-305

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21.0 GENERAL

21.0.10 Scope

This standard covers design and construction of new overhead sub-transmission lines on wood poles for 25kV, 35kV, and 46kV voltage classes. Sub-transmission lines are lines generally used to supply distribution substations, rather than supplying customers through transformers that step down directly to customer service voltages. Occasionally, a few large industrial customers are served directly from sub-transmission lines. Distribution lines are lines generally used to supply customers through transformers that step down directly to customer service voltages rather than supplying distribution substations. For standards applicable to overhead distribution lines at 25kV and 35kV, see Section 20. When planned future conversion of an overhead sub-transmission line requires that it be designed for an operating voltage above 46kV, see transmission standards for applicable construction standards.

21.0.20 Application

This standard contains three basic families of structure configurations: (i) a flat configuration using vertical post insulators on 10' crossarms for 25kV, 35 kV, and 46kV using conductors up to 477 ACSR, (ii) a 4' triangular configuration using vertical post insulators for 25kV and 35 kV using 795 and 1113 ACSR conductors and (iii) a vertical arrangement using horizontal post insulators for 46kV using conductors up to 477 ACSR. Sub-transmission lines operated at 15kV must be built for the 25kV class (or higher if future conversion to a higher class is planned).

This standard is applicable for line angles from zero degrees to 90 degrees. Engineering tables and construction drawings are provided to facilitate selection of the proper structure type, and the correct class of pole to accommodate a coordinated line design. Application of structure types, span lengths, or line angles beyond the limits established herein shall be considered a special case requiring special engineering solutions and should be referred to Distribution Standards or Sub-Transmission Engineering for appropriate solutions.

Supersedes 7/12 Issue – Removed references to 69kV voltage classes.

21.1 GRADE OF CONSTRUCTION

New sub-transmission lines shall be built to NESC Grade B.

When modifying existing sub-transmission lines built on wood poles to allow distribution or communications to share the same poles, NESC Grade C may be used where allowed by the NESC. NESC Grade C is not allowed where the sub-transmission line crosses railroad tracks, limited-access highways or navigable waterways requiring waterway crossing permits. Where a communication line is below a sub-transmission line (at a crossing or on the same structures), NESC Grade C construction is allowed only if both of the following conditions are fulfilled: (a) the supply voltage will be promptly removed from the communications plant by de-energization or other means, both initially and following subsequent circuit-breaker operations in the event of a contact with the communications plant, and (b) the voltage and current impressed on the communications plant in the event of a contact with the supply conductors are not in excess of the safe operating limit of the communications-protective devices.

When modifying existing sub-transmission lines built on structures other than wood poles, NESC Grade B shall be used.

21.2 LOADING CONDITIONS

21.2.10 NESC Heavy District Loading Conditions (NESC Rule 250B Loads)

All poles, cross arms, guys, and insulators must be designed to withstand the load conditions in Table 1 multiplied by the load factors in Table 2 without exceeding the permitted stress levels of the material when multiplied by the strength factor in Table 3.

Table 1
NESC Heavy District Loading Conditions – All Structures

Condition	Temp °F / °C	Ice (Inches)	Wind (mph / PSF)
NESC Heavy (NESC Rule 250B)	0 / -20	0.5	40 / 4.0

Table 2
Load Factors for Structures, Crossarms, Support Hardware, Guys, Foundations, and Anchors to be Used with the Strength Factors of Table 3

Load Factor	Grade B	Grade C	
		At Crossings	Elsewhere
Vertical Loads	1.50	1.90	1.90
Transverse Loads			
Wind	2.50	2.20	2.20
Wire Tension	1.65	1.30	1.30
Longitudinal Loads			
In General	1.10	No requirements	No requirements
At Deadends	1.65	1.30	1.30

Table 3
Strength Factors for Structures, Crossarms, Braces, Support Hardware, Guys, Foundations, and Anchors with the Load Factors of Table 2

Strength Factor	Grade B	Grade C
Metal Braces	1.0	1.0
Wood Poles, Crossarms and Braces	0.65	0.85
Fiberglass Crossarms	1.0	1.0
Support Hardware	1.0	1.0
Guy Wire	0.9	0.9
Guy Anchor	1.0	1.0

21.2.20 Extreme Wind Loading Conditions (NESC Rule 250C Loads)

For structures that extend more than 60 feet above ground, the poles, cross arms, guys, and insulators must be designed to withstand the load conditions in Table 4 multiplied by the load factors in Table 5 without exceeding the permitted stress levels of the material when multiplied by the strength factor in Table 6. In general, this will apply only for wood poles 70 feet long or greater.

For exact boundaries for the Extreme Wind (NESC Rule 250C) loads see NESC Figure 250-2(e).

Supersedes 1/06 Issue – Revised Loading Conditions, Separated Load Cases.

Table 4
Extreme Wind Loading Conditions –
Structures Exceeding 60 Feet Above Ground

NESC Extreme Wind (NESC Rule 250C)	Temp °F / °C	Ice (Inches)	Wind (mph / PSF)
Northern RI	60 /15	0	110 / 31.0
Southern RI	60 /15	0	120 / 36.9

Table 5
Load Factors for Structures, Crossarms, Support Hardware, Guys, Foundations, and Anchors to be Used with the Strength Factors of Table 6

Load Factor	Grade B	Grade C
Transverse Wind Loads	1.00	0.87
All Other Loads	1.00	1.00

Table 6
Strength Factors for Structures, Crossarms, Braces, Support Hardware, Guys, Foundations, and Anchors with the Load Factors of Table 5

Strength Factor	Grade B	Grade C
Metal Braces	1.0	1.0
Wood Poles, Crossarms and Braces	0.75	0.75
Fiberglass Crossarms	1.0	1.0
Support Hardware	1.0	1.0
Guy Wire	0.9	0.9
Guy Anchor	1.0	1.0

21.2.30 Extreme Ice With Concurrent Wind Loading Conditions (NESC Rule 250D Loads)

For structures that extend more than 60 feet above ground, the poles, cross arms, guys, and insulators must be designed to withstand the load conditions in Table 7 multiplied by the load factors in Table 8 without exceeding the permitted stress levels of the material when multiplied by the strength factor in Table 9. In general, this will apply only for wood poles 70 feet long or greater.

For exact boundaries for the Extreme Ice with Concurrent Wind (NESC Rule 250D) loads see NESC Figure 250-3(b).

Table 7
Extreme Ice With Concurrent Wind Loading Conditions –
Structures Exceeding 60 Feet Above Ground

NESC Extreme Ice With Wind (NESC Rule 250D)	Temp °F / °C	Ice (Inches)	Wind (mph / PSF)
Rhode Island	30 / 0	0.75	50 / 6.4

Supersedes 1/06 Issue – Revised Loading Conditions, Separated Load Cases.

Table 8
Load Factors for Structures, Crossarms, Support Hardware, Guys, Foundations, and Anchors to be Used with the Strength Factors of Table 9

Load Factor	Grade B	Grade C
All Loads	1.00	1.00

Table 9
Strength Factors for Structures, Crossarms, Braces, Support Hardware, Guys, Foundations, and Anchors with the Load Factors of Table 8

Strength Factor	Grade B	Grade C
Metal Braces	1.0	1.0
Wood Poles, Crossarms and Braces	0.75	0.75
Fiberglass Crossarms	1.0	1.0
Support Hardware	1.0	1.0
Guy Wire	0.9	0.9
Guy Anchor	1.0	1.0

21.3 SPLICING AND DEADENDING

All in-line splices shall be made with full tension rated compression connectors. For ACSR conductors below 336.4 Kcmil, one die system of compression fittings are specified. For ACSR conductor at 336.4 Kcmil and greater, two piece splices shall be used. Single tube full tension compression splices are used for AAC, AAAC and all other non-ACSR conductors. Automatic splices are excluded from use.

All deadends shall use bolted connectors. Jumper loop connections shall be fired on wedge or partial tension compression splices. For existing lines that contain compression deadends, connection hardware may be maintained for joining the jumper terminal to the deadend body using stainless steel hardware, Belleville washers, and #2 EJC Electrical Joint Compound (NG9D).

Supersedes 7/12 Issue – Revised 21.3 Splicing and Deadending.

21.4 ANCHORS

The preferred anchor type for this standard is the screw anchor. See Section 3 for additional information.

21.5 CONDUCTORS

A number of conductors are preferred for use in the construction of new sub-transmission lines. These include:

- 1/0, 7 Strand, Bare 6201-T81 AAC, “Azuza”
- 336.4 Kcmil, 19 Strand, Bare AAC, “Tulip”
- 336.4 Kcmil, 18/1 Stranding, Bare ACSR, “Merlin”
- 477.0 Kcmil, 19 Strand, Bare AAC, “Cosmos”
- 477.0 Kcmil, 26/7 Stranding, Bare ACSR, “Hawk”
- 795.0 Kcmil, 37 Strand, Bare AAC, “Arbutus”
- 795.0 Kcmil, 54/7 Stranding, Bare ACSR, “Condor”
- 1113.0 Kcmil, 54/19 Stranding, Bare ACSR, “Finch”

While not preferred, some tree wires may be used in the construction of new sub-transmission lines at 35kV and below where required. These conductors are more suitable for use in 35kV distribution lines. Consult Standards or Sub-transmission Engineering before using these conductors in a new sub-transmission line. These conductors include:

- 1/0, 7 Strand, Concentric Round 6201-T81 AAAC, 315 Mil Covered Tree Wire – 35kV
- 477.0 Kcmil, 19 Strand, Compact AAC, 320 Mil Covered Tree Wire – 35kV
- 795.0 Kcmil, 37 Strand, Compact AAC, 320 Mil Covered Tree Wire – 35kV

Pages 21-401 through 21-418 contain detailed information for these conductors, including sag and tension information for these conductors. Structure selection and loading limit information in Section 21.7 Structure

Selection of this standard are based on use of this sag and tension information. Other sags and tensions may be used, but the structure selection and loading limit information in Section 21.7 Structure Selection of this standard may not apply. When sags and tensions other than those contained in this standard are used, appropriate structure selection and loading limits must be developed meeting the requirements of Section 21.2 Loading Conditions above.

21.5.10 Sags and Tensions

All overhead lines must meet minimum clearance requirements of the NESC at the time the line is constructed.

For more information about maximum conductor operating temperatures, see Section 21.6 - Clearances of these standards.

For more details on maximum conductor operating temperatures and conductor ratings see pages 21-400 through 21-418.

21.5.10.1 Limiting Tensions

In the design of overhead sub-transmission lines, three limiting values of tension shall be observed:

A. Initial Unloaded or Stringing Tension is that which will exist before the application of any external load or immediately after new conductors have been installed. The initial unloaded tension at 0˚F/-18˚C shall not exceed 35% of the rated breaking strength of the conductor.

B. Maximum Design Tension is that which will exist on the occurrence of the maximum loading conditions specified in the NESC for the Heavy Loading District. These loading conditions are: (i) conductor temperature of 0˚F/-18˚C, (ii) radial ice on the conductor of 0.5 inches/12.5 mm, and (iii) wind pressure on the conductor of 4 pound per square foot/190 Pa. The maximum conductor tension under NESC Heavy Loading conditions, either initial or final, shall not exceed 50% of the rated breaking strength of the conductor. To limit structure loading conductor maximum design tensions shown in this book are limited to:

   - 4,000 lbs. for 1113 kcmil ACSR;
   - 3,500 lbs. for 795 kcmil ACSR;
   - 3,000 lbs. for 477 & 336 kcmil ACSR, and
   - 2,000 lbs. for all other sub-transmission conductors.

C. Final Unloaded Tension is that which occurs on the conductor with no external loading but after the maximum design tension has been sustained for sufficient time to permit stretching to cease. The final unloaded tension at 0˚F/-18˚C shall not exceed 25% of the rated breaking strength of the conductor.

The sag tables show sags under various temperatures and loading conditions. New conductors strung to “Stringing” (Initial) values will have initial, maximum and final tensions as specified. The sag will increase under design loading, then change as shown in “Final” sags depending on temperature and loading.

The Initial Sag tables are based on the Ruling Span Method of calculation and the Final Sag tables are based on the Deadend Method, described below. If different Initial or Final Sags are required, contact Standards or Sub-transmission Engineering.

Supersedes 1/06 Issue – Added 21.5 Conductors.

21.5.10.2 Deadend or Uniform Spans

Sag tables based on deadend span methods assume that there is only one span or that all spans are the same length. This method is useful for short spans in urban areas where the spacing is reasonably uniform. If long spans in a section of line are sagged according to a deadend table, short spans in the same section will have a sag value that may or may not correspond with the table. For this reason, it is customary to sag a span of average length near the center of the line and to recognize that there may be slightly more or less sag in the longer and shorter spans than is indicated by the tables.

In order to determine the sag value for a specific span length, multiply the ruling span sag value by the ratio provided in Table 10 for the corresponding actual span length. In the event that the needed actual span length is not provided in this table, a method for determining the resultant ratio value is provided below.

Table 10
Ratio of Deadend Span Sag to Sags at Other Span Lengths with Same Tension

ACTUAL SPAN	**DEADEND SPAN**										
	50’	75’	100’	125’	150’	175’	200’	225’	250’	275’	300’
100’	4.00	1.78	1.00	0.64	0.44	0.33	0.25	0.20	0.16	0.13	0.11
110’	4.84	2.15	1.21	0.77	0.54	0.40	0.30	0.24	0.19	0.16	0.13
120’	5.76	2.56	1.44	0.92	0.64	0.47	0.36	0.28	0.23	0.19	0.16
130’	6.76	3.00	1.69	1.08	0.75	0.55	0.42	0.33	0.27	0.22	0.19
140’	7.84	3.48	1.96	1.25	0.87	0.64	0.49	0.39	0.31	0.26	0.22
150’	9.00	4.00	2.25	1.44	1.00	0.73	0.56	0.44	0.36	0.30	0.25
160’	10.24	4.55	2.56	1.64	1.14	0.84	0.64	0.51	0.41	0.34	0.28
170’	11.56	5.13	2.89	1.85	1.28	0.94	0.72	0.57	0.46	0.38	0.32
180’	12.96	5.76	3.24	2.07	1.44	1.06	0.81	0.64	0.52	0.43	0.36
190’	14.44	6.42	3.61	2.31	1.60	1.18	0.90	0.71	0.58	0.48	0.40
200’	16.00	7.11	4.00	2.56	1.78	1.31	1.00	0.79	0.64	0.53	0.44
210’	17.64	7.84	4.41	2.82	1.96	1.44	1.10	0.87	0.71	0.58	0.49
220’	19.36	8.60	4.84	3.10	2.15	1.58	1.21	0.96	0.77	0.64	0.54
230’	21.16	9.40	5.29	3.39	2.35	1.73	1.32	1.04	0.85	0.70	0.59
240’	23.04	10.24	5.76	3.69	2.56	1.88	1.44	1.14	0.92	0.76	0.64
250’	25.00	11.11	6.25	4.00	2.78	2.04	1.56	1.23	1.00	0.83	0.69

Method for Determining Ratio:

1. Choose Deadend Span.
2. Find deadend span sag from sag table for temperature and deadend span desired.
3. Multiply deadend span sag by above ratio for actual spans as line is laid out to obtain actual span.
4. For deadend span to actual span ratio other than those listed above:

$$RATIO = \frac{(ACTUAL\ SPAN)^2}{(DEADEND\ SPAN)^2}$$

21.5.10.3 Ruling Spans

This is a calculated span length for which the conductor tension, under changes in temperature and loading, best represents the average tension in the conductor in a particular series of spans between deadends. Ideally, a line should be installed in such a way that all spans of the line have equal horizontal line tension. If this is done, longitudinal forces on pole tops between spans are

Supersedes 1/06 Issue – Added 21.5 Conductos.

theoretically zero. Deadend poles and poles located at bends in the line will typically require guying in order to counteract the line tension.

Sag tables based on the ruling span method recognize variations in span length. This method assumes that the line will be strung to uniform tension. If this is done, all spans will have initial sags that are very near the values in the table. After the conductors are tied into place, however, and after ice and wind loads stretch the wires, the tension may not be uniform and the sags may vary from the calculated values. If the actual spans are much longer or shorter than the ruling span, the tension and sags may be different than the calculations.

The ruling span can most accurately be determined through the following equation:

$$\text{Ruling Span} = \sqrt{\frac{\left(L_1^3 + L_2^3 + L_3^3 + ..L_N^3\right)}{\left(L_1 + L_2 + L_3 + ..L_N\right)}}$$

Where L1, L2, L3, etc. are the lengths of the first, second, third, etc., spans between deadends.

Spans that are longer than 150% of the average should be avoided or should be sagged independently and guyed to hold the unbalanced tension. All new standard construction for tension should conform to the Company's design which limits tension to 50% of the conductor rated breaking strength by following the above mentioned ruling span calculation.

21.5.10.4 Slack Spans

When guys cannot be installed on the end pole of a line, they may be placed on an adjacent pole. A slack span should then be installed to the end pole. Slack spans may also be necessary for other applications. They are not recommended if there is any way of avoiding them, but when used, calculations should be made as follows:

$$\text{String Sag in Feet} = \frac{W \times L^2}{8 \times T}$$

Where,

W = Total loaded weight lbs./ft.
L = Total length of span in ft.
T = Tension in pounds.
(See Section 2-Poles / Hardware for strength required in poles.)

Example:

50 foot span, 3-336.4 kcmil bare AAC to be deadended on an un-guyed Class 5 pole.
Use T = 200 lb. per conductor.

W = 1.48 lbs./foot (from Page 6-109)
L = 50 feet (span length)
T = 200 lbs.

$$S = \frac{W \times L^2}{8 \times T} = \frac{1.48 \times 50^2}{8 \times 200} = \frac{3700}{1600} = 2.3125\,Feet$$

Sag the conductor at 2.31 feet, at normal temperature. This approximation assumes that the conductors will have 2.31 feet of sag at 0˚F/-18˚C when subject to ice and wind.

Supersedes 1/06 Issue – Added 21.5 Conductors.

21.5.20 Ampacity

Current in overhead line conductors should be limited so that conductors will not be severely annealed or damaged and that clearances are not exceeded. Any line that is desired to be operated at the elevated operating temperature permitted for emergency conditions shall be assessed to verify that available clearances are present to account for the resulting additional sag as outlined in each respective conductor data table. Minimum clearances, outlined in Section 21.6 – Clearances, shallnot be compromised.

To protect conductors from damage caused by excessive heating, the maximum conductor operating temperature (MCOT) for sub-transmission lines shall not exceed the following limits under the design conditions of Table 11:

- 284°F/140°C for bare ACSR conductor,
- 212°F/100°C for bare AAC or AAAC conductor,
- 167°F/75°C for covered conductors,

Table 11
Ampacity Design Parameters

SPECIFICATION	SUMMER	WINTER
Ambient Air Temperature (˚C)	100˚F/37.7˚C	50˚F/10˚C
Wind Speed (FT. / SEC.)	3 FEET/SEC.	3 FEET/SEC.
Angle between Wind and Conductor	90˚	90˚
Coefficient of Emissivity	0.75	0.75
Coefficient of Absorption	0.75	0.75
Climatic Data Record (CDR) elevation above sea level (FT.)	914.2125 FEET	914.2125 FEET
Conductor Direction	North – South	North – South
CDR Latitude in Degrees	42˚	42˚
Solar Heating	12:00 PM (noon)	12:00 PM (noon)
Atmosphere	CLEAR	CLEAR
Conductor Resistance in Ohm/mi. for the Low Temperature @ 77˚F/25˚C	Conductor Specific – In Accordance with Low Conductor Temperature	Conductor Specific – In Accordance with Low Conductor Temperature
Conductor Resistance in Ohm/mi. for the High Temperature @ 167˚F/75˚C	Conductor Specific – In Accordance with High Conductor Temperature	Conductor Specific – In Accordance with High Conductor Temperature

Supersedes 1/06 Issue – Added 21.5 Conductors.

21.6 CLEARANCES

21.6.10 Clearance Requirements for Sub-Transmission Lines

Each vertical and horizontal clearance shall be observed, but within the limits of each other only.

The uniform clearance system contained in the NESC is based on the dimensions of the expected activities in each area and the relative potential problem caused by each type of facility.

In general, vertical clearance requirements must be met during maximum sag conditions to provide for the expected activity beneath the line.

Horizontal clearance requirements must be met with the conductor at rest to provide for the expected activity alongside the line. Conductor "blowout" (wind displacement) is considered under certain conditions (refer to Sections 21.6.70, 21.6.100, 21.6.110 and 21.6.130 and page 21-33).

All clearances listed in this section are based on assumed criteria and should be used for general guidance only. If any actual clearances are found to be less than that given in the tables, they should be brought to the attention of the Distribution Engineering Services Department for further review.

Supersedes 1/06 Issue – Added 21.6 Clearances.

21.6.20 General

21.6.20.1 Clearance Criteria for Sub-Transmission Lines

A. Overhead sub-transmission lines shall be designed to maintain adequate clearances under ice loaded conditions and the line’s maximum conductor operating temperature (MCOT). In no case shall a sub-transmission line be designed for a MCOT below 120°F/48.9°C.

B. The required MCOT of the sub-transmission line shall be determined by the appropriate planning department.

C. To protect conductors from damage caused by excessive heating, the required MCOT for the sub-transmission line shall not exceed the following limits:

   i. 284°F/140°C for bare ACSR conductor,
   ii. 212°F/100°C for bare AAC or AAAC conductor,
   iii. 167°F/75°C for covered conductors,
   iv. 120°F/50°C for spacer cable messengers and 167°F/75°C for spacer cable phase conductors (Phase conductor temperatures higher than 120°F/50°C are taken to have no influence in elevating messenger temperatures.), and
   v. Shielded aerial cables 69 kV and below shall be designed to operate with the messenger at 120°F/50°C ambient (Phase conductor temperatures higher than 120°F/50°C are taken to have no influence in elevating messenger temperatures).

D. New Installations and Extensions Clearances for the installation of all new sub-transmission lines and extensions to existing lines shall be in accordance with the latest edition of the NESC and the requirements of any applicable state or local laws, rules or regulations.

E. Existing Installations Where an existing installation meets, or is altered to meet, the current NESC rules, such installation is considered to be in compliance with the current edition of the NESC and is not required to comply with any previous edition of the NESC.

F. Existing installations, including maintenance replacements, that currently comply with prior editions of the NESC, need not be modified to comply with these standards except as may be required for safety reasons by the administrative authority.

G. Where conductors or equipment are added, altered, or replaced on an existing structure, the structure or the facilities on the structure need not be modified or replaced if the resulting installation will be in compliance with either (a) the NESC rules that were in effect at the time of the original installation, (b) the rules in effect in a subsequent edition of the NESC to which the installation has been previously brought into compliance, or (c) the rules in the latest edition of the NESC.

H. Clearances listed in the following standards and tables are considered minimum requirements for new construction. In some instances clearances exceeding those given may be required (e.g. when mandated by local ordinances). Other design considerations applying to Company work and operating practices may result in clearances greater than NESC minimum clearances.

I. Voltage is the root-mean-square (rms) potential difference between any two conductors or between a conductor and ground. Voltages are expressed in nominal values unless otherwise indicated. Nominal voltage is the value assigned to a system or circuit of a given voltage class for the purpose of convenient designation. Actual operating voltage of the system may vary above or below the nominal voltage.

J. Sub-transmission voltages in the following tables are, unless otherwise noted, given as the nominal phase to phase operating voltage of the sub-transmission line. Voltages for other circuits in the following tables are, unless otherwise noted, given as the highest nominal phase to ground voltage for effectively grounded circuits and for other circuits where all ground faults are cleared by promptly de energizing the faulted section, both initially and following subsequent breaker operations. “Effectively grounded” means intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to limit the buildup of voltages to levels below that which may result in undue hazard to persons or to connected equipment. The voltage of a circuit that is not effectively grounded is the highest nominal voltage available between any two conductors on the circuit.

K. Clearance is defined as the clear distance between two objects measured surface to surface.

L. Spacing is defined as the distance between two objects measured center to center.

M. Clearances for tree wire, covered conductor, and spacer cable conductor are taken as if they were bare conductors.

N. Open conductors are defined as electric supply or communication construction in which the conductors are bare, covered or insulated and without grounded shielding, or individually supported at a structure either directly or with insulators.

O. Electric supply lines are those conductors used to transmit electric energy and their necessary supporting or containing structures.

Supersedes 1/06 Issue – Added 21.6 Clearances.

21.6.20.2 NESC Vertical Clearance Requirements Illustration – Rules 232 & 235

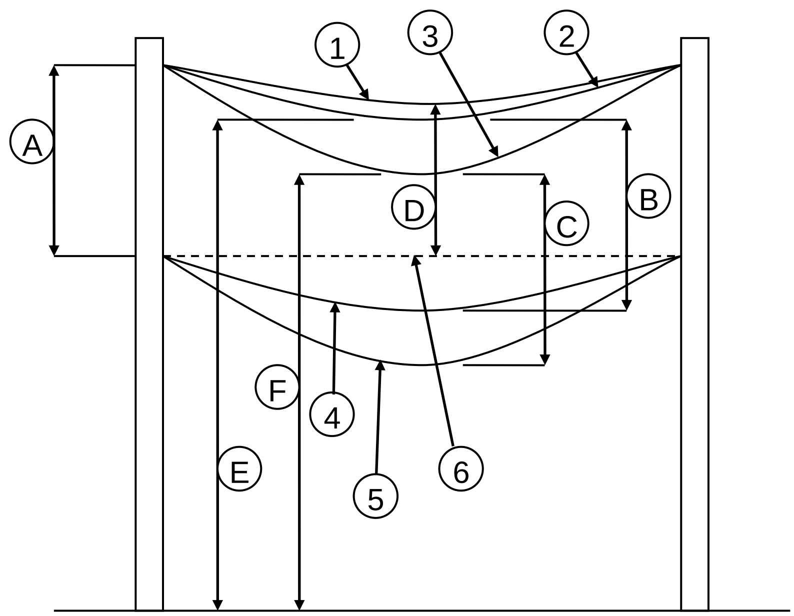


Figure 1

WIRES AND CABLES

1 – Lowest sub-transmission conductor at 60ºF/15.6ºC, final unloaded sag.
2 – Lowest sub-transmission conductor at the greater of its maximum conductor operating temperature (MCOT) or 120ºF/48.9ºC, final unloaded sag.
3 – Lowest sub-transmission conductor at 32ºF/0ºC, final loaded sag, with 1/2” radial ice and no wind.
4 – Next wire or cable (supply or communication space) below sub-transmission at 50ºF/10ºC, final unloaded sag.
5 – Next wire or cable (supply or communication space) below sub-transmission at 32ºF/0ºC, final unloaded sag.
6 – Straight line between attachment points of communications space wire or cable below sub-transmission.

CLEARANCES

A – Minimum vertical clearance required at pole between lowest sub-transmission conductor and next wire or cable (supply or communication space) below it.
B – Minimum vertical clearance required anywhere in span between lowest sub-transmission conductor at condition 2 above and next wire or cable (supply or communication space) below it at condition 4 above (ambient condition corresponding to winter rating).
C – Minimum vertical clearance required anywhere in span between lowest sub-transmission conductor at condition 3 above and next wire or cable (supply or communication space) below it at condition 5 above (ambient condition corresponding to NESC Heavy Loading condition).
D – For spans greater than 150 feet, minimum vertical clearance required anywhere in span between lowest sub-transmission conductor at condition 1 above and a straight line between attachment points of a communications space wire or cable.
E – Minimum vertical clearance above ground required anywhere in span below lowest sub-transmission conductor at condition 2 above.
F – Minimum vertical clearance above ground required anywhere in span below lowest sub-transmission conductor at condition 3 above.

Supersedes 1/06 Issue – Added 21.6 Clearances.

21.6.30 Relative Levels

21.6.30.1 At Crossings or Conflicts

Where supply lines of different voltage classifications cross each other or structure conflict exists, the higher-voltage lines should, where practical, be carried at the higher level.

21.6.30.2 For Wires, Conductors, or Cables Carried On The Same Supporting Structure

Where supply lines, all owned by PPL, of different voltage classifications are on the same structures, the conductors of higher voltage should, where practical, be placed above those of lower voltage.

21.6.40 Clearances Of Supporting Structures From Rail, Curb, Hydrant & Other Objects

Poles for overhead sub-transmission lines shall be located with adequate clearance to railroad and automobile traffic. The following table, Table 12, identifies NESC minimum requirements. These requirements should be exceeded if practicable. State and local authorities prefer that poles be set back as far as possible from the pavement edge, and behind guard rails, ditches, sidewalks, curbs, or other features that may help isolate poles from traffic. In any case, the approval of the authorities shall be obtained. To the extent practicable, avoid placing poles at exposed corners or similar locations where they are likely to be struck by motor vehicles or snow removal equipment.

Supersedes 1/06 Issue – Added 21.6 Clearances.

Table 12
Clearance of Supporting Structures from Rail, Curb or Hydrant
(Reference: NESC Rule 231)

Supporting structures [1], support arms, attached equipment, and braces shall have the following clearances measured between the nearest parts of the objects concerned:

Objects	**Minimum (Ft.)**	**Recommended (Ft.)**
A. Fire Hydrants	3 [2,3]	4 [2]
B. Streets, Roads, Highways [4]	***Horizontal Clearance for First 15 Feet Above Ground***	
1. With street curbs (measured from street side of the curb)		
a. Arterial Streets which are primarily for through traffic	0.5	2 [2,5]
b. Local Streets which are primarily for access to residences, businesses or other abutting properties	0.5	1 [2]
2. With no curbs		See Footnote 6
C. All Railroad Tracks	***Horizontal Clearance for First 22 Feet Above the Nearest Track Rail***	
	12 [7]	

FOOTNOTES:

1. Supporting structures are defined as the main supporting unit, usually a pole or tower.
2. This clearance also applies to anchor guys and push braces.
3. EXCEPTION: Clearance may be reduced by agreement with the local fire authority.

4. Where a governmental authority exercising jurisdiction over structure location has issued a permit for, or otherwise approved, specific locations for supporting structures, that permit or approval shall govern.
5. Place the supporting structures as far as practical behind the curb within the road right of way.
6. Place the supporting structures a sufficient distance from the roadway to avoid contact by ordinary vehicles using the traveled way.
7. This may be reduced to 7 feet where the supporting structure is not the controlling obstruction, provided sufficient space for a driveway is left where the cars are loaded and unloaded.

21.6.50 Vertical Clearances Of Wires, Conductors, and Cables Above Ground, Roadway, Rails, Etc.

21.6.5.1 Generally Applicable Clearances

Clearances, found in Table 13, apply under the following conductor temperature and loading conditions, whichever produces the largest final sag:

A. 120°F/50°C, no wind displacement,
B. The maximum conductor temperature for which the line is designed to operate, if greater than 120°F/50°C, with no wind displacement,
C. 32°F/0°C, no wind displacement, with 0.5 inch radial thickness of ice.

Supersedes 7/12 Issue – Removed references to 69kV.

Table 13
Minimum Vertical Clearance of Wires, Conductors, and Cables Above Ground, Roadways, or Rails (Reference: NESC Table 232-1)

Nature of Surface Underneath Wires, Conductors, or Cables	Grounded Guys [14,15]	25 kV (ft.)	35 kV (ft.)	46 kV (ft.)
Where wires, conductors, or cables cross over or overhang				
1. Track rails of railroads (not using overhead electric supply conductors) [2, 16, 22]	23.5	26.7	27.0	27.4
2. Roads, streets, and other areas subject to truck traffic [23]	15.5	18.7	19.0	19.4
3. Driveways, parking lots, and alleys [23]	15.5 [13]	18. 7	19.0	19.4
4. Land traversed by vehicles, such as cultivated, grazing, forest, orchards, etc. [26]	15.5	18. 7	19.0	19.4
5. Spaces and ways subject to pedestrians or restricted traffic only [9]	9.5	14. 7	15.0	15.4
Where wires, conductors or cables run along highway or rights-of-way but do not overhang the roadway				
6. Roads, streets, or alleys	15.5	18. 7	19.0	19.4
7. Roads in rural districts where it is unlikely that vehicles will be crossing under the line	13.5 [10]	16. 7	17.0	17.4

FOOTNOTES:

Note: Footnotes 1, 3-8, 11-12, 17-21, and 24-25 from NESC Table 232-1 are not used.

2. For wires, conductors, or cables crossing over mine, logging, or similar railways that handle only cars lower than standard freight cars, the clearance may be reduced by an amount equal to the difference in height between the highest loaded car handled and 20 feet, but the clearance shall not be reduced below that required for street crossings.

9. Spaces and ways subject to pedestrians or restricted traffic only are those areas where riders on horseback or other large animals, vehicles, or other mobile units exceeding a total height of 8 feet are prohibited by regulation or permanent terrain configurations or are otherwise not normally encountered nor reasonably anticipated.
10. Where a sub-transmission line along a road is located relative to fences, ditches, embankments, etc., so that ground under the line would not be expected to be traveled except by pedestrians, the clearances for guys may be reduced to 9.5 feet.
13. Where this construction crosses over or runs along alleys, driveways, or parking lots not subject to truck traffic, this clearance may be reduced to 15 feet.
14. Ungrounded guys and ungrounded portions of span guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed due to slack conductor or guy.
15. Insulated anchor guys may have the same clearance as grounded guys. Insulators shall be installed as follows: (a) all guy insulators or span-wire insulators shall be located at a position such that the bottom of the insulator shall be not less than 2.45 m (8 ft) above the ground if the guy or span wire is broken below the insulator, (b) insulators shall be so placed that, in case any guy or span-wire contacts, or is contacted by, an energized conductor or part, the voltage will not be transferred to other facilities on the structure(s), and (c) insulators shall be so placed that in case any guy or span wire sags down upon another, the insulators will not become ineffective.
16. Adjacent to tunnels and overhead bridges that restrict the height of loaded rail cars to less than 20 ft, these clearances may be reduced by the difference between the highest loaded rail car handled and 20 ft, if mutually agreed to by the parties at interest.
22. See Section 7.7 for the required horizontal and diagonal clearances to rail cars.
23. For the purpose of this Rule, trucks are defined as any vehicle exceeding 8 feet in height. Areas not subject to truck traffic are areas where truck traffic is not normally encountered nor reasonably anticipated.
26. When designing a line to accommodate oversized vehicles, these clearance values shall be increased by the difference between the known height of the oversized vehicle and 14 feet.

Supersedes 7/12 Issue – removed references to 69kV from Table 15.

21.6.5.2 Clearances required <u>by local Administrative Authorities</u>

The clearances shall not be less than required by the Administrative Authority (Table 14).

Table 14
Vertical Clearance of Wires, Conductors, and Cables Above Ground, Railroads or Water Surfaces - Compliance With Administrative Authority

Supersedes 7/12 Issue – Removed references to 69kV from Table 14.

Nature of surface underneath wires, conductors or cables	Grounded guy, span or surge protection wire (FT)	Open Supply Conductors 23 kV to 46 kV (FT)
Corp of Engineers – Navigable Waters	Requirements not available	27
Railroad Tracks	27	33

21.6.60 <u>Vertical Clearance Of Wires, Conductors and Cables Above Water Surfaces</u>

Vertical clearances of sub-transmission supply wires and conductors over waterways shall not be less than those shown on Table 15: Vertical Clearance Above Water Surfaces. For canals and

Table 15
Vertical Clearance Above Water Surface
(Reference: NESC Table 232-1)

Nature of Surface Underneath Wires, Conductors, or Cables	Ref. Height (ft.)	Grounded Guys [14,15] (ft.)	25 kV (ft.)	35 kV (ft.)	46 kV (ft.)
Where wires, conductors, or cables cross over or overhang					
1. Water areas not suitable for sailboating or where sailboating is prohibited [21]	12.5	14	17.2	17.5	17.9
2. Water areas suitable for sailboating including lakes, ponds, reservoirs, tidal waters, rivers, streams, and canals with an unobstructed surface area of: [17, 18, 19, 20, 21]					
a. Less than 20 acres	16	17.5	20.7	21	21.4
b. Over 20 to 200 acres	24	25.5	28.7	29	29.4
c. Over 200 to 2000 acres	30	31.5	34.7	35	35.4
d. Over 2000 acres	36	37.5	40.7	41	41.4
3. Established boat ramps and associated rigging areas; areas posted with sign(s) for rigging or launching sailboats		Clearance aboveground shall be 5 ft greater than in 2 above, for the type of water areas served by the launching site			

Supersedes 7/12 issue – Removed references to 69kV from Table 16.

FOOTNOTES:

NOTE: Footnotes 1-13, 16, and 22-25 from NESC Table 232-1 are not used.

14. Ungrounded guys and ungrounded portions of span guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed due to a slack conductor or guy.

15. Insulated anchor guys may have the same clearance as grounded guys. Insulators shall be installed as follows: (a) all guy insulators or span-wire insulators shall be located at a position such that the bottom of the insulator shall be not less than 2.45 m (8 ft) above the ground if the guy or span wire is broken below the insulator, (b) insulators shall be so placed that, in case any guy or span-wire contacts, or is contacted by, an energized conductor or part, the voltage will not be transferred to other facilities on the structure(s), and (c) insulators shall be so placed that in case any guy or span wire sags down upon another, the insulators will not become ineffective.

17. For controlled impoundments, the surface area and corresponding clearances shall be based upon the design high-water level.

18. For uncontrolled water flow areas, the surface area shall be that enclosed by its annual high-water mark. Clearances shall be based on the normal flood level; if available, the 10-year flood level may be assumed as the normal flood level.

19. The clearance over rivers, streams, and canals shall be based upon the largest surface area of any 1 mile long segment that includes the crossing. The clearance over a canal, river, or stream normally used to provide access for sailboats to a larger body of water shall be the same as that required for the larger body of water.

20. Where an over-water obstruction restricts vessel height to less than the applicable reference height given in Table 15, the required clearance may be reduced by the difference between the reference

height and the over-water obstruction height, except that the reduced clearance shall not be less than that required for the surface area on the line crossing side of the obstruction.

21. Where the US Army Corps of Engineers, or the state, or surrogate thereof has issued a crossing permit, clearances of that permit shall govern, if greater.

21.6.70 Clearances Over or Near Swimming Areas

Sub-transmission supply wires and conductors should not pass over a swimming pool or the surrounding land within 25 feet around the edge of the pool. If such crossings cannot be reasonable avoided, the clearances shown below in Table 16 shall be obtained.

For all spans, horizontal clearances must be increased to allow for conductor “blowout” as shown on Page 21-33.

21.6.70.1 Swimming Pools

Where sub-transmission lines cross over a swimming pool or the surrounding area, the clearances in any direction shall not be less than those shown in Table 5 below. This rule does not apply to a pool enclosed by a solid or screened permanent structure.

21.6.70.2 Beaches and Waterways Restricted to Swimming

Where sub-transmission lines cross over a supervised swimming beach, where rescue poles are used by lifeguards, the clearances in any direction shall not be less than those shown in Table 16 below. Where rescue poles are not used, the clearances shall be as specified in Section 21.6.50.

21.6.70.3 Waterways Subject to Water Skiing

Where sub-transmission lines cross over a waterway subject to water skiing, the clearances shall be as specified in Section 21.6.60.

Supersedes 7/12 Issue – Removed reference to 69kV from Table 17.

Table 16
Clearance to Swimming Pools
(Reference: NESC Table 234-3, Figure 234-3, Rules 232 and 234)

	Grounded Guys [1,2]	25 kV	35 kV	46 kV
		(ft.)	(ft.)	(ft.)
A. Clearance in any direction from the water level, edge of pool, base of diving platform, or anchored raft	22	25.2	25.5	25.9
B. Clearance in any direction to the diving platform, tower, water slide, or other fixed, pool-related structures	14	17.2	17.5	17.9
V. Vertical clearance to adjacent land	Clearances specified in Section 21.6.50 & 21.6.60			

NOTE: A, B, and V are shown in Figure 2, below.

FOOTNOTES:

1. Ungrounded guys and ungrounded portions of guys between insulators shall have clearances based on the highest voltage to which they may be exposed due to a slack conductor or guy.
2. Insulated anchor guys may have the same clearance as grounded guys. Insulators shall be installed as follows: (a) all guy insulators or span-wire insulators shall be located at a position such that the bottom of the insulator shall be not less than 2.45 m (8 ft) above the ground if the guy or span wire is

broken below the insulator, (b) insulators shall be so placed that, in case any guy or span-wire contacts, or is contacted by, an energized conductor or part, the voltage will not be transferred to other facilities on the structure(s), and (c) insulators shall be so placed that in case any guy or span wire sags down upon another, the insulators will not become ineffective.

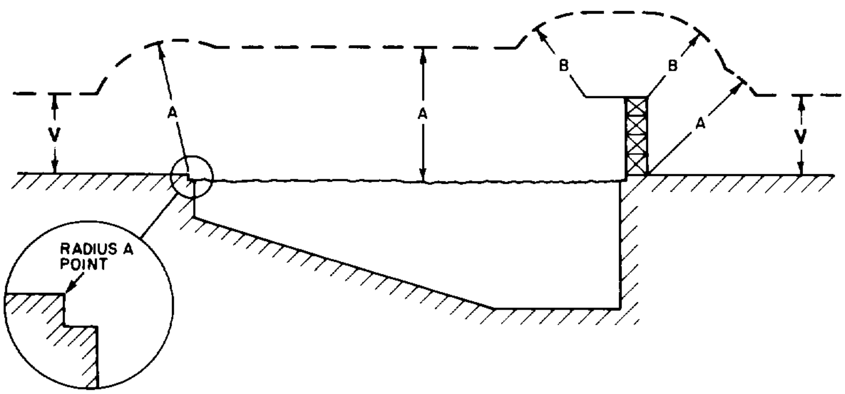


Figure 2

21.6.80 Vertical & Horizontal Clearance Of Wires, Conductors And Cables To Rail Cars

Where sub-transmission lines run along railroad tracks, the clearance in any direction shall not be less than that shown in Figure 3 and Table 17 below.

Table 17
Clearance to Rail Cars [1]
(Reference: NESC Figure 234-5 and Rule 234I)

	Grounded Guys [3]	25 kV (ft.)	35 kV (ft.)	46 kV (ft.)
V	3.5	6.7	7.0	7.4
H	8.5	11.7	12.0	12.4

NOTE: V and H are shown in Figure 3, below.

FOOTNOTES:

1. If the Railroad crossed requires greater clearances than detailed in this Standard, the Railroad clearances shall apply.

3. Anchor guys shall not be located less than 12 feet from the nearest track rail. Insulated guys may have the same clearance as grounded guys. Insulators shall be installed as follows: (a) all guy insulators or span-wire insulators shall be located at a position such that the bottom of the insulator shall be not less than 2.45 m (8 ft) above the ground if the guy or span wire is broken below the insulator, (b) insulators shall be so placed that, in case any guy or span-wire contacts, or is contacted by, an energized conductor or part, the voltage will not be transferred to other facilities on the structure(s), and (c) insulators shall be so placed that in case any guy or span wire sags down upon another, the insulators will not become ineffective. Ungrounded guys and ungrounded portions of span guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed due to slack conductor or guy.

4. For 69 kV, the clearance specified in Table 6 shall be increased 0.6 in for each 1000 ft in excess of 3300 ft above mean sea level.

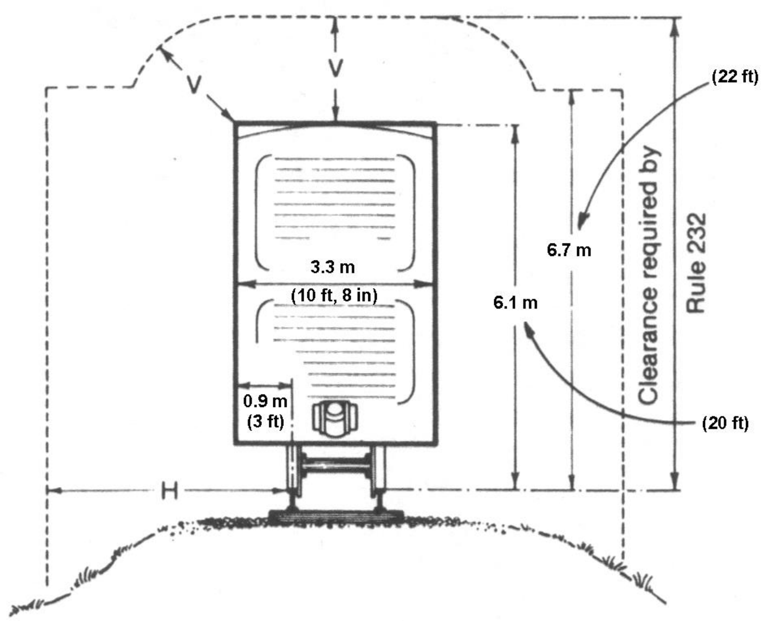


Figure 3

21.6.90 <u>Vertical Clearance Of Equipment Cases and Rigid Live Parts Of Equipment Mounted On Structures</u>

Where sub-transmission lines have equipment cases or rigid live parts, the clearance of such equipment cases or rigid live parts shall not be less than that shown in Table 18 below.

Supersedes 7/12 Issue – Removed footnote 4 reference to 69kV.

Supersedes 7/12 Issue – Removed references to 69kV from Table 18.

Table 18
(Reference: NESC Rule 232B, Table 232-2)

Note These vertical clearances above ground or roadway surfaces are for unguarded rigid live parts such as potheads, transformer bushings, surge arresters, and short lengths of connecting supply conductors which are not subject to variations in sag.

Nature of Surface Below	Clearance Above Ground or Roadway			
	Effectively Grounded Equipment Cases	Rigid Live Parts		
	(ft.)	25 kV (ft.)	35 kV (ft.)	46 kV (ft.)
1. Where rigid parts overhang:				
a. Roads, streets and other areas subject to truck traffic.[4]	15	18.2	18.5	18.9
b. Driveways, parking lots and alleys.	15	18.2	18.5	18.9
c. Other land traversed by vehicles such as cultivated land, grazing land, forest, orchard, etc.	15.0 [7]	18.2	18.5	18.9
d. Spaces and ways subject to pedestrians or restricted traffic only. [5]	11.0 [7]	14.2	14.5	14.9
2. Where rigid parts are along and within the limits of highways or other road rights-of-way but do not overhang the roadway.				
a. Roads, streets and alleys.	15.0 [7]	18.2	18.5	18.9
b. Roads in rural districts where it is unlikely that vehicles will be crossing under the line.	13.0 [7]	16.2	16.5	16.9
3. Water areas not suitable for sailboating or where sailboating in prohibited. [9]	14	15.25	15.5	15.9

FOOTNOTES:

Note: Footnotes 1, 2, 3, 6, and 8 will not be used.

4. For the purpose of this rule, trucks are defined as any vehicle exceeding 8 ft in height. Areas not subject to truck traffic are areas where truck traffic is not normally encountered nor reasonably anticipated.
5. Spaces and ways subject to pedestrians or restricted traffic only are those areas where riders on horseback or other large animals, vehicles or other mobile units exceeding 8 ft in height, are prohibited by regulation or permanent terrain configurations or are otherwise not normally encountered nor reasonably anticipated.
7. Effectively grounded switch handles and supply or communication equipment cases (such as fire alarm boxes, control boxes, communication terminals, meters, or similar equipment cases) may be mounted at a lower level for accessibility provided such cases do not unduly obstruct a walkway. Such switch handles and equipment cases shall be located so as not to serve as a means of approach to unguarded rigid live parts by unqualified persons.

9. Where the US Army Corps of Engineers, or the state, or surrogate thereof has issued a crossing permit, clearance of that permit shall govern.

21.6.100 Clearance Of Wires, Conductors, Cables and Unguarded Live Parts To Buildings, Signs, Billboards, Chimneys, Radio and Television Antennas, Tanks and Other Installations Except Bridges

Sub-transmission conductors should not be installed over buildings. There are cases, however, especially for temporary work, where such construction cannot be avoided. The clearance of sub-transmission lines over or near buildings and appurtenances shall be as much as is practicable. In no case shall it be less than shown below.

For open supply conductors, the minimum vertical and horizontal clearances shown in Table 19 shall apply under whichever of the following conditions of conductor temperature and loading produces the closest approach:

(a) 120°F, no wind displacement, final sag.
(b) The maximum conductor temperature for which the line is designed to operate, no wind displacement, final sag.
(c) 32°F, no wind displacement, with ½" radial thickness of ice, final sag.
(d) The minimum conductor temperature for which the line is designed to operate, no wind displacement, initial sag.

For open supply conductors, the minimum horizontal clearances shown in Table 20 shall apply with the wires, conductors or cables displaced from rest by a 6 lb/ft2 wind at final sag at 60°F. The displacement of the wires, conductors or cables shall include the displacement of suspension insulators. If the highest wire, conductor or cable is installed 60 ft or more above grade, the displacement of the wires, conductors or cables shall include the deflection of a flexible structure.

The transition between vertical and horizontal clearance requirements shall be as shown in Figure 4 below.

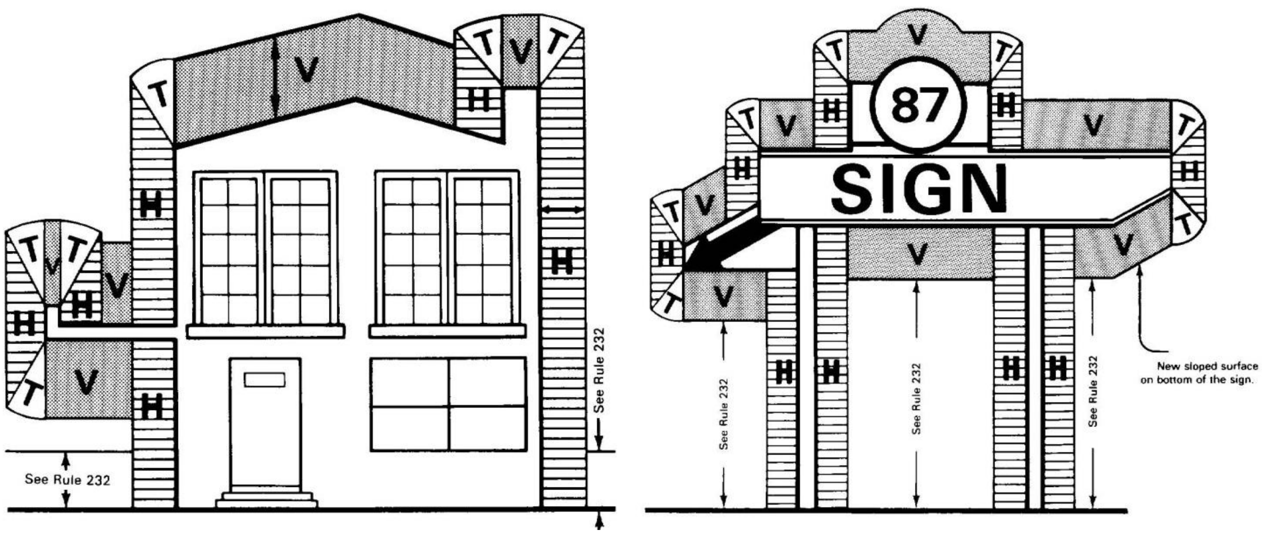


Figure 4
Regions Where Conductors Are Prohibited:
H = Horizontal; V = Vertical; T = Transitional = Vertical (Arc)

Supersedes 1/06 Issue – Added 21.6 Clearances.

Supersedes 7/12 Issue – Deleted Footnote 1 to match 2017 NESC.

Table 19
Clearance of Wires, Conductors, Cables and Unguarded Rigid Live Parts Adjacent But Not Attached to Buildings And Other Installations Except Bridges
(Reference: NESC Tables 234-1 and Rules 232 and 234)

Clearance of:	Grounded Guys	Unguarded rigid live parts, ungrounded equipment cases, ungrounded guys exposed to live parts			Open supply conductors		
	(ft.)	25 kV (ft.)	35 kV (ft.)	46 kV (ft.)	25 kV (ft.)	35 kV (ft.)	46 kV (ft.)
1. Buildings							
a. Horizontal							
(1) To walls, projections, and guarded windows	4.5 [2,7]	7.2 [2]	7.5 [2]	7.9 [2]	7.7[2,10,11]	8.0[2,10,11]	8.4[2,10,11]
(2) To unguarded windows [8]	4.5	7.2	7.5	7.9	7.7 [10,11]	8.0 [10,11]	8.4 [10,11]
(3) To balconies and areas readily accessible to pedestrians [3]	4.5	7.2	7.5	7.9	7.7 [10,11]	8.0 [10,11]	8.4 [10,11]
b. Vertical [14]							
(1) Over or under roofs or projections not readily accessible to pedestrians [3]	3	12.2	12.5	12.9	12.7	13	13.4
(2) Over/under balconies and roofs readily accessible to pedestrians [3]	10.5	13.2	13.5	13.9	13.7	14	14.4
(3) Over roofs accessible to vehicles but not subject to truck traffic [6]	10.5	13.2	13.5	13.9	13.7	14	14.4
(4) Over roofs accessible to truck traffic [6]	15.5	18.2	18.5	18.9	18.7	19	19.4
2. Signs, chimneys, billboards, radio and TV antennas, tanks, and other installations not classified as buildings or bridges							
a. Horizontal [4]							
(1) To portions that are readily accessible to pedestrians [3]	4.5	7.2 [2]	7.5 [2]	7.9 [2]	7.7 [10,11]	8.0 [10,11]	8.4 [10,11]
(2) To portions that are not readily accessible to pedestrians [3]	3	7.2 [2]	7.5 [2]	7.9 [2]	7.7[2,10,11]	8.0[2,10,11]	8.4[2,10,11]
b. Vertical							
(1) Over/under catwalks and other surfaces upon which personnel walk	10.5	13.2	13.5	13.9	13.7	14	14.4
(2) Over/under other portions of such installations [4]	3	7.7	8	8.4	8.2	8.5	8.9
3. Clearance from other supporting structures [15]							
a. Horizontal (no wind)	3	5	5	5	5	5	5
b. Vertical	2	5.5	5.5	5.5	5.5	5.5	5.5

FOOTNOTES:

Note: Footnote 1 is not used.

2. Where available space may not permit this value, the clearance may be reduced by 2 feet provided the wires, conductors, or cables, including splices and taps, and unguarded live parts have a covering that provides sufficient dielectric strength to limit the likelihood of a short circuit in case of momentary contact with a structure or building.
3. A roof, balcony, or area is considered readily accessible to pedestrians if it can be casually accessed through a doorway, ramp, window, stairway, or permanently mounted ladder by a person on foot who neither exerts extraordinary physical effort nor employs special tools or devices to gain entry. A permanently mounted ladder is not considered a means of access if its bottom rung is 8 feet or more from the ground or other permanently installed accessible surface.
4. The required clearances shall be to the closest approach of motorized signs or moving portions of the signs, billboards, chimneys, radio and television antennas, tanks, and other installations except bridges.
5. Ungrounded guys and ungrounded portion of guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed to a slack conductor or guy.
6. For purpose of this rule, trucks are defined as any vehicle exceeding 8 feet in height.
7. This clearance may be reduced to 3 inches for the grounded portions of guys.
8. Windows not designed to open may have the clearances permitted for walls and projections.
10. The clearance at rest shall be not less than the value shown in this table. Also, when the conductor or cable is displaced by wind, the clearance shall be not less than the minimum clearances shown in Table 9, below.
11. Where available space will not permit this value, the clearance may be reduced to 7feet for conductors limited to 8.7 kV to ground.
13. The anchor end of insulated anchor guys may have the same clearance as grounded guys. Insulators shall be installed as follows: (a) all guy insulators or span-wire insulators shall be located at a position such that the bottom of the insulator shall be not less than 2.45 m (8 ft) above the ground if the guy or span wire is broken below the insulator, (b) insulators shall be so placed that, in case any guy or span-wire contacts, or is contacted by, an energized conductor or part, the voltage will not be transferred to other facilities on the structure(s), and (c) insulators shall be so placed that in case any guy or span wire sags down upon another, the insulators will not become ineffective.
14. For clearances above railings, walls, or parapets around balconies or roofs, use the clearances required for roofs not accessible to pedestrians.
15. Other supporting structures include those to which the conductor is not attached, such as lighting support, a traffic signal support, and a supporting structure of another line.

Supersedes 7/12 Issue – Deleted Footnote 1 to match 2017 NESC.

Table 20
Horizontal Clearance of Wires, Conductors, Cables Under Wind Displacement Conditions

Conductor or Cable	Horizontal Clearance Required when Displaced by Wind		
	25 kV (ft.)	35 kV (ft.)	46 kV (ft.)
Open Supply Conductor	4.7	5	5.4

Note:

Sample calculations for accounting for wind displacement can be found on Page 21-33.

21.6.110 Clearance To Bridges

Sub-transmission conductors may be located adjacent to or within a bridge structure

The clearance over pedestrian walks or over roadways on bridges shall meet the requirements of Table 13 in Section 21.6.50.

For open supply conductors, the minimum vertical and horizontal clearances shown in Table 21 shall apply under whichever of the following conditions of conductor temperature and loading produces the closest approach:

(a) 120°F, no wind displacement, final sag.
(b) The maximum conductor temperature for which the line is designed to operate, no wind displacement, final sag.
(c) 32°F, no wind displacement, with ½" radial thickness of ice, final sag.
(d) The minimum conductor temperature for which the line is designed to operate, no wind displacement, initial sag.

For open supply conductors, the minimum horizontal clearances shown in Table 22 shall apply with the wires, conductors or cables displaced from rest by a 6 lb/ft2 wind at final sag at 60°F. The displacement of the wires, conductors or cables shall include the displacement of suspension insulators. If the highest wire, conductor or cable is installed 60 ft or more above grade, the displacement of the wires, conductors or cables shall include the deflection of a flexible structure.

The transition between vertical and horizontal clearance requirements shall be as shown in Figure 4 above.

Supersedes 7/12 Issue removed reference to 69kV in Table 20.

Table 21
Horizontal and Vertical Clearance of Wires, Conductors, Cables, and Unguarded Rigid Live Parts from Bridges
(Reference: NESC Tables 234 – 2 and Rules 234D1a and 234H4)

Clearance of:	Unguarded rigid live parts, ungrounded equipment cases, ungrounded guys exposed to live parts [4]			Open supply conductors		
	25 kV (ft.)	35 kV (ft.)	46 kV (ft.)	25 kV (ft.)	35 kV (ft.)	46 kV (ft.)
1. Clearance over bridges [1]						
a. Attached [3]	5.2	5.5	5.9	5.7	6	6.4
b. Not Attached	12.2	12.5	12.9	12.7	13	13.4
Clearance beside, under, or within bridge structure [6]						
a. Readily accessible portions of any bridge including wing, walls, and bridge attachments [1]						
(1) Attached [3]	5.2	5.5	5.9	5.7 [9]	6.0 [9]	6.4 [9]
(2) Not Attached	7.2	7.5	7.9	7.7 [9]	8.0 [9]	8.4 [9]
b. Ordinarily inaccessible portions of bridges (other than brick, concrete, or masonry) and from abutments [2]						
(1) Attached [3,5]	5.2	5.5	5.9	5.7 [9]	6.0 [9]	6.4 [9]
(2) Not Attached [4,5]	6.2	6.5	6.9	6.7 [9]	7.0 [9]	7.4 [9]

FOOTNOTES:

Note: Footnotes 7, 8 and 10 are not used.

1. Where over traveled ways on or near bridges, the clearances of Section 21.6.50 shall also apply.
2. Bridge seats of steel bridges carried on masonry, brick, or concrete abutments that require frequent access for inspection shall be considered as readily accessible portions.
3. Clearance from sub-transmission conductors to supporting arms and brackets owned, operated, or maintained by the Company and attached to bridges shall be the same as specified from Surfaces of Supports in Table 26 in Section 21.6.150.
4. Ungrounded guys and ungrounded portions of guys between guy insulators shall have clearances based on the highest voltage to which they may be exposed due to a slack conductor or guy.
5. Where conductors passing under bridges are adequately guarded against contact by unauthorized persons and can be de-energized and grounded for maintenance of the bridge, clearances of the conductors from the bridge, at any point, may have the clearances specified from Surfaces of Supports in Table 26 in Section 21.6.150 plus one-half the final unloaded sag of the conductor at that point.
6. Where the bridge has moving parts, such as a lift bridge, the required clearances shall be maintained throughout the full range of movement of the bridge or any attachment thereto.
9. The clearance at rest shall be not less than the value shown in this Table. Also, when the conductor or cable is displaced by wind, the clearance shall be not less than shown in Table 22, below.

Supersedes 7/12 Issue – removed references to 69kV from Table 21.

Table 22
Horizontal Clearance of Wires, Conductors, Cables Under Wind Displacement Conditions

Conductor or Cable	Horizontal Clearance Required when Displaced by Wind		
	25 kV (ft.)	35 kV (ft.)	46 kV (ft.)
Open Supply Conductor	4.7	5	5.4

Note:

Sample calculations for accounting for wind displacement can be found on Page 21-33.

21.6.120 Separation Of Conductors and Supports On The Same Pole

21.6.120.1 General

Minimum vertical clearances between sub-transmission wires, conductors, or cables and other wires, conductors, or cables carried on the same supporting structures are shown in Table 23A for wires, conductors, or cables owned by the same utility and in Table 23B for wires, conductors, or cables owned by different utilities. These minimum vertical clearances shall be met or exceeded on all new poles. Where the recommended separations in other sections of these standards exceed these minimum vertical clearances, those separations should be used for poles in new lines. Where the recommended separations in other sections of these standards exceed these minimum vertical clearances, those separations should generally be used for pole replacements in existing lines except where such separations are not practicable in the existing line. These vertical clearances are suggested minimum clearances; separations should be increased to provide additional safety protection wherever possible.

“At Pole” clearances are the vertical clear space separation requirements, surface-to-surface, at the pole.

“In-Span” clearances are the vertical clear space separation requirements, surface-to-surface, at any location in the span. Vertical clearances at the supporting structures shall be adjusted so that the vertical clearance at any point in the span shall be not less than the required “In-Span” clearance under whichever of the following conditions produces the greater vertical clearance at the structure:

i. The upper conductor is at final sag at 120°F or the maximum operating temperature for which the line is designed to operate and the lower conductor is at final sag at the same ambient conditions as the upper conductor without electrical loading, or

ii. The upper conductor is at final sag at 32°F with ½” radial thickness of ice (NESC Heavy Loading District) and the lower conductor is at final sag at the same ambient conditions as the upper conductor without electrical loading, and without ice loading.

Supersedes 7/12 Issue – Removed reference to 69kV from Table .

Table 23A
Vertical Clearance Between Conductors Owned by the Same Utility
(Reference: NESC Rules 235A, C and Table 235-5)

Conductors and Cables Usually at Lower Levels	Open Supply Conductors and Cables Usually At Upper Levels							
	25 kV		35 kV		46 kV		69 kV	
	At Pole (in.)	In-Span (in.)	At Pole (in.)	In-Span (in.)	At Pole (in.)	In-Span (in.)	At Pole (in.)	In-Span (in.)
1. Communication Conductors and Cables								
a. Located in the communication space	40	30	40	30	40	30	49	39
b. Located in the supply space	40 [10]	30 [10]	40 [10]	30 [10]	40 [10]	30 [10]	49 [10]	39 [10]
2. Supply conductors and cables								
a. Open conductors 0-750 V; supply cables meeting Rule 230C1, 2, or 3; neutral conductors meeting Rule 230E1 [11]	24	18	28	21	32	24	42	34
b. Open conductors over 750 V-8.7 kV	24 [4a]	18 [4b]	28 [4a]	21 [4b]	35 [4a]	27 [4b]	45 [4a]	37 [4b]
c. Open conductors over 8.7-22 kV								
(1) If worked on alive with live-line tools and adjacent circuits are neither de-energized nor covered with shields or protectors	24	18	31	24	40	32	51	43
(2) If not worked on alive except when adjacent circuits (either above or below) are de-energized or covered by shields or protectors, or by use of live-line tools not requiring line workers to go between live wires	24 [3]	18 [3]	31 [3]	24 [3]	40 [3]	32 [3]	51 [3]	43 [3]
2. Open supply conductors and cables exceeding 22 kV	Contact Distribution Standards Department							

Table 23B
Vertical Clearance Between Conductors Owned by Different Utilities
(Reference: NESC Rules 235A, C and Table 235-5)

Conductors and Cables Usually at Lower Levels	Open Supply Conductors and Cables Usually At Upper Levels							
	25 kV		35 kV		46 kV		69 kV	
	At Pole (in.)	In-Span (in.)	At Pole (in.)	In-Span (in.)	At Pole (in.)	In-Span (in.)	At Pole (in.)	In-Span (in.)
1. Communication Conductors and Cables								
a. Located in the communication space	48	36	52	39	56	42	66	52
b. Located in the supply space	48 [10]	36 [10]	52 [10]	39 [10]	56 [10]	42 [10]	66 [10]	52 [10]
2. Supply conductors and cables								
a. Open conductors 0-750 V; supply cables meeting Rule 230C1, 2, or 3; neutral conductors meeting Rule 230E1 [11]	48	36	52	39	56	42	66	52
b. Open conductors over 750 V-8.7 kV	48	36	52	39	56	42	66	52
c. Open conductors over 8.7-22 kV								
(1) If worked on alive with live-line tools and adjacent circuits are neither de-energized nor covered with shields or protectors	48	36	55	42	64	50	75	61
(2) If not worked on alive except when adjacent circuits (either above or below) are de-energized or covered by shields or protectors, or by use of live-line tools not requiring line workers to go between live wires	24 [3]	18 [3]	31 [3]	24 [3]	40 [3]	32 [3]	51 [3]	43 [3]
2. Open supply conductors and cables exceeding 22 kV	Contact Distribution Standards Department							

Supersedes 1/06 Issue – Added 21.6 Clearances.

NOTES:

When using column and row headings, voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de energizing the faulted section, both initially and following subsequent breaker operations.

For span lengths in excess of 45 m (150 ft), vertical clearance at the structure between 25 kV, 35 kV and 46 kV open supply conductors and communication space cables or conductors shall be adjusted so that under conditions of conductor temperature of 15 °C (60 °F), no wind displacement and final unloaded sag, the open supply conductor shall not be lower in the span than a straight line joining the points of support of the highest communication cable or conductor. For span lengths in excess of 45 m (150 ft), vertical clearance at the structure between 69 kV open supply conductors and communication space cables or conductors shall be adjusted so that under conditions of conductor temperature of 15 °C (60 °F), no wind displacement and final unloaded sag, the open supply conductor shall not be lower in the span than 9” above a straight line joining the points of support of the highest communication cable or conductor.

FOOTNOTES:

3. These values do not apply to conductors of the same circuit or circuits being carried on adjacent conductor supports.
4. May be reduced where conductors are not worked on energized except when adjacent circuits (either above or below) are de-energized or covered by shields or protectors, or by the use of live line tools not requiring line workers to go between live wires:
   a. to 16 in at pole,
   b. to 12 in in-span.
10. No clearance is specified between fiber-optic supply cables meeting Rule 230F1b and supply cables and conductors.
11. Does not include neutral conductors meeting Rule 230E1.

21.6.120.2 Separation on Replaced Poles

In general, the separations on poles that are replaced shall conform to the requirements for new poles. In some special cases, separation may be reduced, but shall not be less than permitted on existing poles.

21.6.120.3 Reduction of Separation on Poles

Reduced separations of conductors and facilities made to accommodate communication, community antenna television (CATV), or other third party interest shall not be less than 15 kV minimum requirements.

21.6.120.4 Basic Impulse Level (BIL) & Air – Wood Spacing

BIL refers to the ability of the pole top design to resist flashovers caused by lightning or line surges.

Sub-transmission pole tops are generally designed to provide 150 kV minimum insulation withstand value. This impulse strength shall be based entirely on the impulse flashover of 20 inches or more of wood. Where lightning arresters are used, the “inches of wood” requirement does not apply for the particular conductor having the arrester. In locations where sufficient wood separation is not obtainable due to guy attachment, the use of a fiberglass guy strain insulator will meet this requirement. Additionally, insulated pole top pins (P6B and P6C), long strain insulators (I2), guy strain insulator (I24, TI95B, TI95C, TI95D), and wood braces (TB60 & B37B) may be used to provide the necessary separation if it cannot be met with standard hardware.

Supersedes 1/06 Issue – Added 21.6 Clearances.

In design and construction of pole tops, avoid shorting out the insulation provided by air and wood with steel crossarm braces, steel hardware, ground wires, guy wires, etc. The total distance measured over insulators, wood, and air should be as great as possible.

21.6.120.5 Climbing Space

Standard pole top designs shall meet or exceed code requirements for vertical or lateral clearance for line conductors at different levels attached to the same pole. When various designs are combined, however, or when work is done on an existing pole, care should be taken to provide good clearance and to maintain climbing and working space. Page 7-127 shows the NESC clearance required when workers must climb through energized conductors. This drawing should be used as a guide even when the conductors concerned are covered by protective equipment or otherwise guarded as an unvarying practice before personnel climb past them.

The climbing space needs to be provided on one side or a corner of the support only.

Vertical runs physically protected by conduit or other protective covering securely attached without spacers to the surface of the pole are not considered to obstruct climbing space.

The climbing space shall extend vertically in the same position 40 inches above and 40 inches below any wire attachment, but may otherwise be shifted to any other adjacent side or corner of the pole.

All voltages in Table 24 are between the two conductors bounding the climbing space, except for communications conductors, which are voltage to ground. Where two conductors are in different circuits, the voltage between conductors shall be the arithmetic sum of the voltages of each conductor to ground for a grounded circuit or phase to phase for an ungrounded circuit.

Table 24
Horizontal Climbing Space Between Conductors
(Reference: NESC Rule 236 and Table 236-1)

Character of Conductors Adjacent to Climbing Space	Voltage of Conductors	Horizontal Clearance Between Conductors Bounding the Climbing Space [3,4,5]		
		On S.O. Structures used Solely By Supply Conductors (Inches)	On J.O. Structures: Supply Conductors Above Communication Conductors (Inches)	On J.O. Structures: Communication Conductors Above Supply Conductors [1] (Inches)
Open Supply Line Conductors and Supply Cables Meeting Rule 230D	25 kV	36	36	36
	35 kV	40	40	
	46 kV	46	46	
	69 kV	54	54	

FOOTNOTES:

Footnotes 2 and 3 are not used.

1. This level relation is undesirable, in general, and should be avoided.
4. The climbing space specified in Table 13 above shall be provided above the top support arm to the ridge pin conductor but need not be carried past it.
5. All supply equipment such as transformers, capacitors, cable terminations, switches, etc. when located below conductors or other attachments, shall be mounted outside the climbing space.

Supersedes 1/06 Issue – Added 21.6 Clearances.

21.6.130 Clearance To Property Line

In general, conductors and supports shall not overhang property lines unless a right of way or easement has been obtained. In checking overhang, it should be assumed that conductors on rigid supports will be deflected by wind at the amount calculated on Page 21-33.

Plan for future buildings or structures along the property lines, or, if local ordinances specify, along the established building line. If it is probable that a structure will be erected in the foreseeable future, the right-of-way should be adequate to provide standard clearances to such a structure.

21.6.140 Clearance Between Wires, Conductors and Cables At Point Of Crossing On Different Supporting Structures

It is generally undesirable to build a sub-transmission line directly over or under another line. Where this cannot be avoided, clearance should be provided so that a man working on the top of a pole will be able to maintain adequate working clearances from conductors overhead.

The conductor movement envelope shall be developed from the locus of the most displaced conductor positions defined below and shown in Figure 5:

(1) 15 °C (60 °F), no wind displacement, at both initial unloaded and final unloaded sag (conductor positions A and C).

(2) With the wire, conductor, or cable displaced from rest by a 290 Pa (6 lb/ft2) wind at both initial and final sag at 15 °C (60 °F). The displacement of the wire, conductor, or cable shall include deflection of suspension insulators and flexible structures (conductor positions B and D).

> EXCEPTION: Where the entire span is so close to a building, terrain feature, or other obstacle as to be sheltered from the wind flowing across the line in either direction, the wind pressure may be reduced to a 190 Pa (4 lb/ft2) wind. Trees are not considered to shelter a line.

(3) Final sag at one of the following loading conditions, whichever produces the largest sag (conductor position E):

- (a) 50 °C (120 °F), no wind displacement,
- (b) The maximum conductor temperature for which the line is designed to operate, if greater than 50 °C (120 °F), with no wind displacement, or
- (c) 0 °C (32 °F), no wind displacement, with 0.5 inch radial thickness of ice.

Supersedes 1/06 Issue – Added 21.6 Clearances.

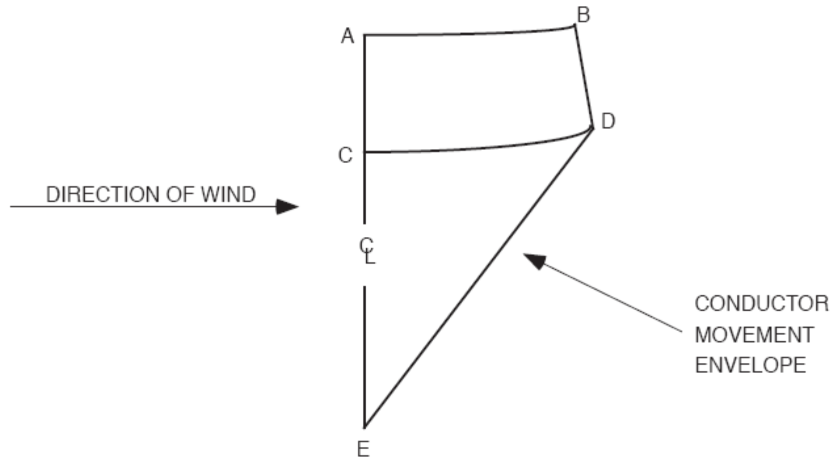


Figure 5

The horizontal clearance between crossing or adjacent wires, conductors, or cables carried on different supporting structures shall be not less than 5 ft.

Supersedes 1/06 Issue – Added 21.6 Clearances.

Table 25
Vertical Clearance Between Wires, Conductors, and Cables Carried on Different Supporting Structures
(Reference: NESC Rule 233, Table 233-1)

	Upper Level				
	Effectively grounded supply guys, span wires, neutral conductors meeting Rule 230E1, and overhead shield / surge-protection wires	**Open supply conductors**			
Lower Level	**(ft)**	**25 kV (ft)**	**35 kV (ft)**	**46 kV (ft)**	**69 kV (ft)**
1. Effectively grounded supply guys [7], span wires, neutral conductors meeting Rule 230E2, and overhead shield/surge-protection wires	2.0 [1,2]	2.2	2.5	2.9	3.7
2. Effectively grounded communication guys [7], conductors and cables, and messengers	2.0 [1,2]	5.2 [8]	5.5 [8]	5.9 [8]	6.7 [8]
3. Supply cables meeting Rule 230C1, and supply cables of 0-750 V meeting Rules 230C2 or 230C3	2.0	2.2	2.5	2.9	3.7
4. Open supply conductors, 0-750 V [6]; supply cables over 750 V meeting Rule 230C2 or 230C3	2.0 [9]	2.2	2.5	2.9	3.7
5. Open supply conductors, 750 V-22 kV	2.0 [9]	2.2	2.5	2.9	3.7

NOTES:

1. For lower-level conductors exceeding 22 kV, the clearance given in Table 25 shall be increased at the rate of 0.4 in per kV in excess of 22 kV.

2. For 69 kV, the clearance specified in Table 10 shall be increased 0.6 in for each 1000 ft in excess of 3300 ft above mean sea level.

FOOTNOTES:

Note: Footnotes 3, 4, 5, and 6 are not used.

1. No clearance is specified between guys or span wires that are electrically interconnected.
2. The clearance of communication conductors and their guy span, and messenger wires from each other in locations where no other classes of conductors are involved may be reduced by mutual consent of the parties concerned, except for fire-alarm conductors and conductors used in the operation of railroads.
6. Does not include neutrals that are effectively grounded throughout their length and are associated with circuits of 0 to 22 kV to ground.
7. These clearances may be reduced by not more than 25% to a guy insulator, provided that full clearance is maintained to its metallic end fittings and the guy wires. The clearance to an insulated section of a guy between two insulators may be reduced by not more than 25% provided that full clearance is maintained to the un-insulated portion of the guy.
8. This clearance may be reduced by 3 feet for supply service drops.
9. In general, this type of crossing is not recommended.

Supersedes 1/06 Issue – Added 21.6 Clearances.

21.6.150 Clearances Of Vertical and Lateral Supply Conductors From Other Wires & Surfaces Of The Same Structure

Minimum clearances between vertical and lateral sub-transmission conductors from other wires and surfaces of the supporting structures are shown, in general, in Table 26. Table 27 shows minimum clearances between vertical and lateral sub-transmission conductors from other wires and surfaces of the supporting structures are shown for portions of a structure that workers ascend while the conductors in question are energized.

Table 26
Clearances of Open Lateral and Vertical Conductors
(Circuit Phase-to Phase Voltages, Reference: NESC Rule 239E, Table 239-1)

Clearances of Open Vertical & Lateral Conductors	Phase to Phase Voltage			
	25 kV (Inches)	35 kV (Inches)	46 kV (Inches)	69 kV [4] (Inches)
From Surfaces of Supports	7	9	11	16 [4a]
From Span, Guy and Messenger Wires [5]	14	18	22	32 [4b]
Anchor Guys	11	14	16	29 [4c]

FOOTNOTES:

4. The clearance for 69 kV specified in Table 26 shall be increased by the following amounts:
   a. For clearances from surfaces of supports: Increase by 0.15 in / 1000 ft in excess of 3300 ft above mean sea level,
   b. For clearances from span, guy, and messenger wires: Increase by 0.27 in / 1000 ft in excess of 3300 ft above mean sea level, and
   c. For clearances from anchor guy wires: Increase by 0.18 in / 1000 ft in excess of 3300 ft above mean sea level.

5. These clearances may be reduced by not more than 25% to a guy insulator, provided that full clearance is maintained to its metallic end fittings and the guy wires. The clearance to an insulated section of a guy between two insulators may be reduced by not more than 25% provided that full clearance is maintained to the un-insulated portion of the guy.

Table 27 [5]
Clearance Between Open Vertical Conductors and Pole Surface (Figures 6 & 7)
(Circuit Phase-to Phase Voltages, Reference: NESC Rule 239E, Table 239-2)

Clearances of Open Vertical & Lateral Conductors	Phase to Phase Voltage			
	25 kV (Inches)	35 kV (Inches)	46 kV (Inches)	69 kV [4] (Inches)
From Surfaces of Supports	7	9	11	16 [4a]
From Span, Guy and Messenger Wires [5]	14	18	22	32 [4b]
Anchor Guys	11	14	16	29 [4c]

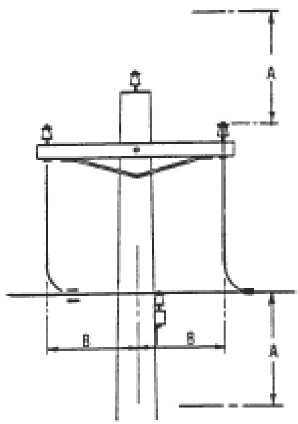


Figure 6

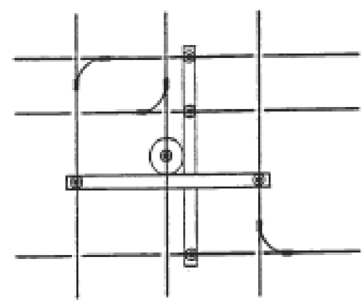


Figure 7

A = zone above and below conductor
B = distance between vertical wire and pole center

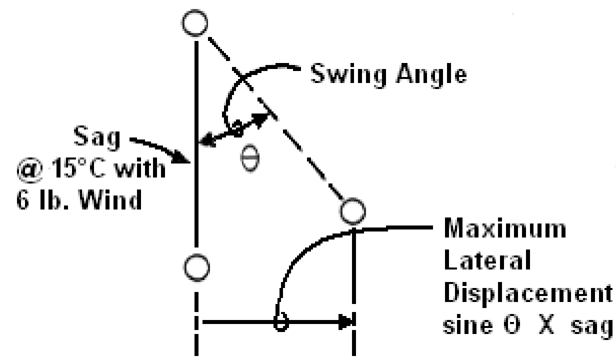
Supersedes 1/06 Issue – Added 21.6 Clearances.

Basic HORIZONTAL clearances shown in Section 21.6.110 must be increased as follows to allow for wind caused lateral conductor displacement. For horizontal adders between conductors carried on different poles (Table 22), apply adder for only one of the conductors.

The vertical sag at 60°F/15°C final with 6 lb. wind taken from conductor information on pages 21-401 through 21-418 for the subject conductor and span is multiplied by the sine of the conductor's swing angle to obtain maximum conductor horizontal movement.

The sine of the swing angle may be calculated or taken from the following table (rounding up to the next value shown).

Swing Angle (Θ)	Sine
25°	0.4226
30°	0.5000
35°	0.5736
40°	0.6428
45°	0.7071
50°	0.7660
55°	0.8192
60°	0.8660



Example:

For a 200 feet span of 336.4 kcm AAC 19 Strand Bare (Std. Item W20B)

1. Swing Angle = 46.5degrees (from Page 21-417)
2. Multiplier = 0.7660 (from table above for 50°)
3. Sag at 60°F/15°C, 6 lb. wind for 200 foot span = 48.36 inches (from Page 21-418)
4. Maximum Lateral Displacement = (48.36 inches) X (0.7660) = 37.04 inches

Note:

If point of conflict is not at point of maximum sag, the additional horizontal clearance may be reduced as follows:

If the distance between point of crossing or clearance and the nearest support is ___% of the total span, multiply additional clearance by the multiplier outlined below.

Percent of Span	Multiplier
5%	0.19
10%	0.36
15%	0.51
20%	0.64
25%	0.75
30%	0.84
35%	0.91
40%	0.96
45%	0.99
50%	1.00
*Interpolate for intermediate vales or use next higher multiplier.	

Supersedes 1/06 Issue – Added 21.6 Clearances.

21.7 STRUCTURE TYPE SELECTION

This standard contains three basic families of structure configurations:

(i) Flat configuration using vertical post insulators on 10’ crossarms for 25kV, 35 kV, and 46kV with conductors up to 477 ACSR (see Standards Pages 21-211 through 21-218 and 21-236),
(ii) 4’ Triangular configuration using vertical post insulators for 25kV and 35 kV using 795 and 1113 ACSR conductors (see Standards Pages 21-101 through 21-109) and
(iii) Vertical configuration using horizontal post insulators for 25kV, 35kV, and 46kV with conductors up to 477 ACSR (see Standards Pages 21-224 through 21-230).

For load breaks and other protection devices, see Section 12 - Protection

In general, the vertical configuration is preferred for new line construction. The flat configuration fits well into many existing line configurations throughout the system for new or replacement structures in existing lines, in short line extensions and where a lower line profile is desirable. The 4’ triangular configuration should only be used when 795 or 1113 ACSR is required at 25kV or 35kV.

Within each family of structures, the structure type is selected based on the line angle. Each structure drawing title indicates the range of or maximum line angles for which the structure may be used.

Allowable span lengths are limited by a variety of considerations including: (i) loads from wires and the strengths of the supporting poles, crossarms, insulators and hardware, (ii) required clearances between conductors and (iii) where appropriate, conductor gallop.

Tables 28 through 34 contain span limits for each of the structure types considering (i) loads from wires and the strengths of the supporting crossarms, insulators and hardware, (ii) required clearances between conductors and (iii) where appropriate, conductor gallop. These tables are applicable only for standard conductors strung at standard tensions and sags included in pages 21-401 through 21-418 of these standards. These tables do not apply when other sags and tensions are used and appropriate limits for the tensions and sags actually used must be determined. These tables do not take pole strength into consideration and appropriate pole strength must be considered separately.

These tables contain span limits based on conductor gallop. Conductor gallop is not always a factor, but span lengths should be limited based on gallop clearances when the line is built in open, level terrain. When considering gallop, the gallop limit for span length applies to all structure types in the family of structures. Conductor gallop is a large amplitude movement of conductors that occurs in open terrain. Gallop is generally associated with steady wind over entire spans of conductors with some ice on the conductors. Gallop does not normally occur in areas where the wind is not steady over an entire span because parts of the span are sheltered by trees or buildings or where uneven terrain makes the wind flow across a span turbulent. Gallop clearances do not need to considered when the line is built in an area with trees that are close to the height of the line or when the line is built through an area where terrain or buildings near the line will make winds across the line turbulent rather than steady across the entire span.

Supersedes 7/12 Issue – Moved to pp 21-34 from 21-36.

Table 28
Maximum Allowable Spans
4'Triangular Configuration – 25kV

CONDUCTOR	Double Arm / Single Insulator 21-101 (3 deg) (ft.)	Double Arm / Single Insulator 21-102 (6 deg) (ft.)	Double Arm / Double Insulator 21-103 (15 deg) (ft.)	Other Str. Types 21-104 --- 21-109 (ft.)	Gallop Limited (ft.)
1113.0 KCMIL, 54/19 STRANDING, BARE ACSR, "FINCH"	408	289	460	502	200
795.0 KCMIL, 54/7 STRANDING, BARE ACSR, "CONDOR"	464	349	521	521	210

Table 29
Maximum Allowable Spans
4'Triangular Configuration – 35kV

CONDUCTOR	Double Arm / Single Insulator 21-101 (3 deg) (ft.)	Double Arm / Single Insulator 21-102 (6 deg) (ft.)	Double Arm / Double Insulator 21-103 (15 deg) (ft.)	Other Str. Types 21-104 --- 21-109 (ft.)	Gallop Limited (ft.)
1113.0 KCMIL, 54/19 STRANDING, BARE ACSR, "FINCH"	408	289	460	502	200
795.0 KCMIL, 54/7 STRANDING, BARE ACSR, "CONDOR"	464	349	482	521	210

Supersedes 7/12 Issue – Moved to pp 21-35 from 21-37.

Table 30
Maximum Allowable Spans
Flat Configuration – 25kV

CONDUCTOR	Single Arm / Single Insulator 21-211 (2 deg) (ft.)	Double Arm / Single Insulator 21-217 (2 deg) (ft.)	Double Arm / Single Insulator 21-220 (8 deg) (ft.)	Double Arm / Double Insulator 21-236 (8 deg) (ft.)	Other Str. Types (ft.)	Gallop Limited (ft.)
477.0 KCMIL, 26/7 STRANDING, BARE ACSR, “HAWK”	324	577	357	629	643	310
477.0 KCMIL, 19 STRAND, BARE AAC, “COSMOS”	387	559	471	559	559	270
477.0 KCMIL, 19 STRAND, COMPACT AAC, 320 MIL COVERED TREE WIRE – 35 kV	242	464	358	464	464	***
336.4 KCMIL, 18/1 STRANDING, BARE ACSR, “MERLIN”	350	577	436	660	660	350
336.4 KCMIL, 19 STRAND, BARE AAC, “TULIP”	457	608	507	608	608	290
1/0, 7 STRAND, BARE 6201-T81 AAAC, “AZUZA”	660	660	604	660	660	360
1/0, 7 STRAND, CONCENTRIC ROUND 6201-T81 AAAC, 315 MIL COVERED TREE WIRE – 35 kV	351	539	417	539	539	***

*** If tree wire is required, the line should be in an area where it is sheltered by trees and gallop should not be a concern.

Supersedes 7/12 Issue – Moved to pp 21.36 from 21-38.

Table 31
Maximum Allowable Spans
Flat Configuration – 35kV

CONDUCTOR	Single Arm / Single Insulator 21-211 (2 deg) (ft.)	Double Arm / Single Insulator 21-217 (2 deg) (ft.)	Double Arm / Single Insulator 21-220 (8 deg) (ft.)	Double Arm / Double Insulator 21-236 (8 deg) (ft.)	Other Str. Types (ft.)	Gallop Limited (ft.)
477.0 KCMIL, 26/7 STRANDING, BARE ACSR, “HAWK”	303	577	357	584	603	310
477.0 KCMIL, 19 STRAND, BARE AAC, “COSMOS”	361	523	471	523	523	270
477.0 KCMIL, 19 STRAND, COMPACT AAC, 320 MIL COVERED TREE WIRE – 35 kV	228	435	358	435	435	***
336.4 KCMIL, 18/1 STRANDING, BARE ACSR, “MERLIN”	326	577	436	643	660	350
336.4 KCMIL, 19 STRAND, BARE AAC, “TULIP”	425	570	507	570	570	290
1/0, 7 STRAND, BARE 6201-T81 AAAC, “AZUZA”	618	660	604	660	660	360
1/0, 7 STRAND, CONCENTRIC ROUND 6201-T81 AAAC, 315 MIL COVERED TREE WIRE – 35 kV	327	505	417	505	505	***

*** If tree wire is required, the line should be in an area where it is sheltered by trees and gallop should not be a concern.

Supersedes 7/12 Issue – Moved to pp 21-37 from 21-35.

Table 32
Maximum Allowable Spans
Flat Configuration – 46kV

CONDUCTOR	Single Arm / Single Insulator 21-211 (2 deg) (ft.)	Double Arm / Single Insulator 21-217 (2 deg) (ft.)	Double Arm / Single Insulator 21-220 (8 deg) (ft.)	Double Arm / Double Insulator 21-236 (8 deg) (ft.)	Other Str. Types (ft.)	Gallop Limited (ft.)
477.0 KCMIL, 26/7 STRANDING, BARE ACSR, “HAWK”	290	558	357	556	558	310
477.0 KCMIL, 19 STRAND, BARE AAC, “COSMOS”	345	485	471	485	485	270
336.4 KCMIL, 18/1 STRANDING, BARE ACSR, “MERLIN”	313	577	436	616	659	350
336.4 KCMIL, 19 STRAND, BARE AAC, “TULIP”	504	527	507	527	527	290
1/0, 7 STRAND, BARE 6201-T81 AAAC, “AZUZA”	586	660	604	660	660	360

Supersedes 7/12 Issue – Moved to pp 21-38 from 21-40 and removed table 33.

Table 34
Maximum Allowable Spans
Vertical Configuration – 46kV

CONDUCTOR	Single Arm / Single Insulator 21-211 (2 deg) (ft.)	Gallop Limited (ft.)
477.0 KCMIL, 26/7 STRANDING, BARE ACSR, “HAWK”	660	300
477.0 KCMIL, 19 STRAND, BARE AAC, “COSMOS”	660	260
477.0 KCMIL, 19 STRAND, COMPACT AAC, 320 MIL COVERED TREE WIRE – 35 kV	543	***
336.4 KCMIL, 18/1 STRANDING, BARE ACSR, “MERLIN”	660	340
336.4 KCMIL, 19 STRAND, BARE AAC, “TULIP”	660	280
1/0, 7 STRAND, BARE 6201-T81 AAAC, “AZUZA”	660	350
1/0, 7 STRAND, CONCENTRIC ROUND 6201-T81 AAAC, 315 MIL COVERED TREE WIRE – 35 kV	660	***

*** If tree wire is required, the line should be in an area where it is sheltered by trees and gallop should not be a concern.

Supersedes 7/12 Issue – Moved to pp 21.39 from 21-41 and removed references to 69kV.

21.8 INSULATORS

The types of insulators used in Sub-transmission construction are as follows.

21.8.10 Post Top

Porcelain post insulators with trunnion style conductor clamps shall be used for all bare wire installations where line guards are available. Tie top polymer line post insulators shall be used in all other applications.

21.8.20 Disc

Porcelain ball and socket disc insulators are used for all deadend applications and some limited suspension applications.

21.8.30 Impulse / Non-Impulse Design

The drawings in sections 21-100 and 21-200 are designed to "Impulse Design" meaning that the basic insulation level (BIL) of the wood crossarms is considered in addition to the BIL attained with the line insulator. "Non-impulse Design" is a design where the insulator is supported by a conductive surface such as steel poles, steel crossarms, lattice towers or bonded wood crossarms effectively reducing BIL versus Impulse Design. To account for the loss in BIL for Non-impulse Design, additional insulation is required as shown in Table 35.

Table 35
Sub-Transmission Insulator Selection Table

Impulse Design – Wood					
				Suspension Disc Insulator	
Operating Voltage	Tie Top	Horizontal Line Post	Line Post	Number in Dead-end	Number in Suspension
23	I13AP	I13J	I13B	3	3
34.5	I13CP	I13J	I13D	3	3
46	I13EP	I13J	I13L	4	4
Non-Impulse Design – Bonded Wood, Steel Poles or Towers					
				Suspension Disc Insulator	
Operating Voltage	Tie Top	Horizontal Line Post	Line Post	Number in Dead-end	Number in Suspension
23	I13AP	I13J	I13D	3	3
34.5	I13CP	I13J	I13L	3	3
46	I13EP	I13K	I13M	4	4

Note: 1. In areas with known contamination:
   a. Use the next higher rating of post insulators.
   b. Use one additional suspension insulator or use fog type insulators.
2. Ensure that additional insulation does not violate electrical clearances.

Supersedes 7/17 Issue - Updated 21.8.10 and removed 21.8.30.

21.9 Risk Mitigation at Line Crossings and Critical Crossings

21.9.10 In order to supply additional safety insurance at line crossings and critical crossings, the following are to be incorporated into designs.

Higher voltage circuits should cross over lower voltage circuits.

Limit upper circuits to crossing only one lower circuit in a single span.

Use shorter spans and lower tensions in upper circuits.

Look for ways to avoid line crossings in initial design.

21.9.20 For all line crossings and critical crossings, double insulator strings assemblies as shown on page 21-42 and 21-43 shall be used on both structures either side of the crossing. Double insulator strings shall be used at the following locations:

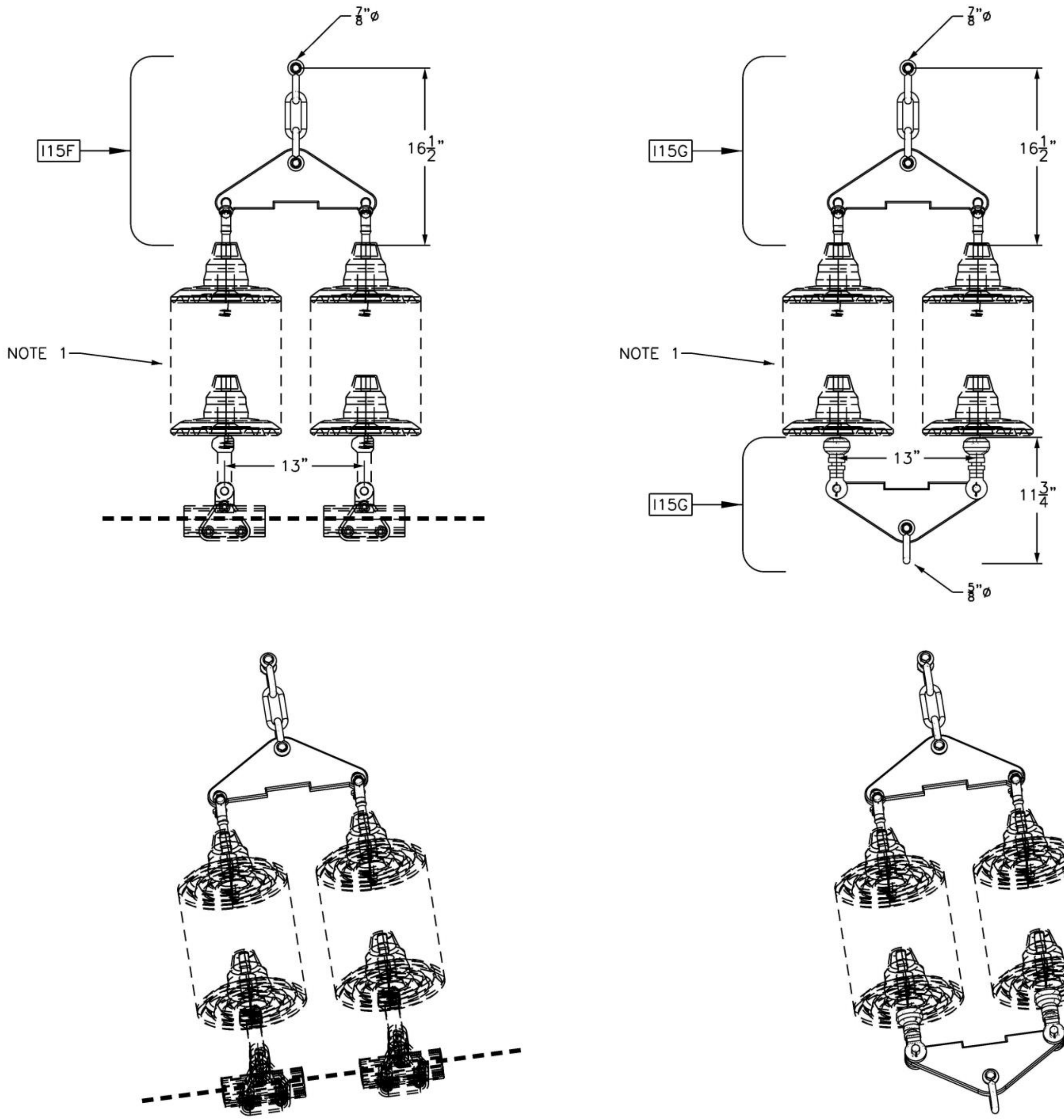
Limited access highways

Licensed navigable waterways

Rail-Roads

Sub-transmission circuits

7/17 New Issue.



7/17 New Issue.

I15F	
1	ANCHOR SHACKLE–7/8"
1	CHAIN LINK
1	ANCHOR SHACKLE–3/4"
1	YOKE
2	BALL CLEVIS

VOLTAGE	SUSPENSION INSULATOR ID
25KV	I8C(3)
35KV	I8C(3)
46KV	I8C(4)

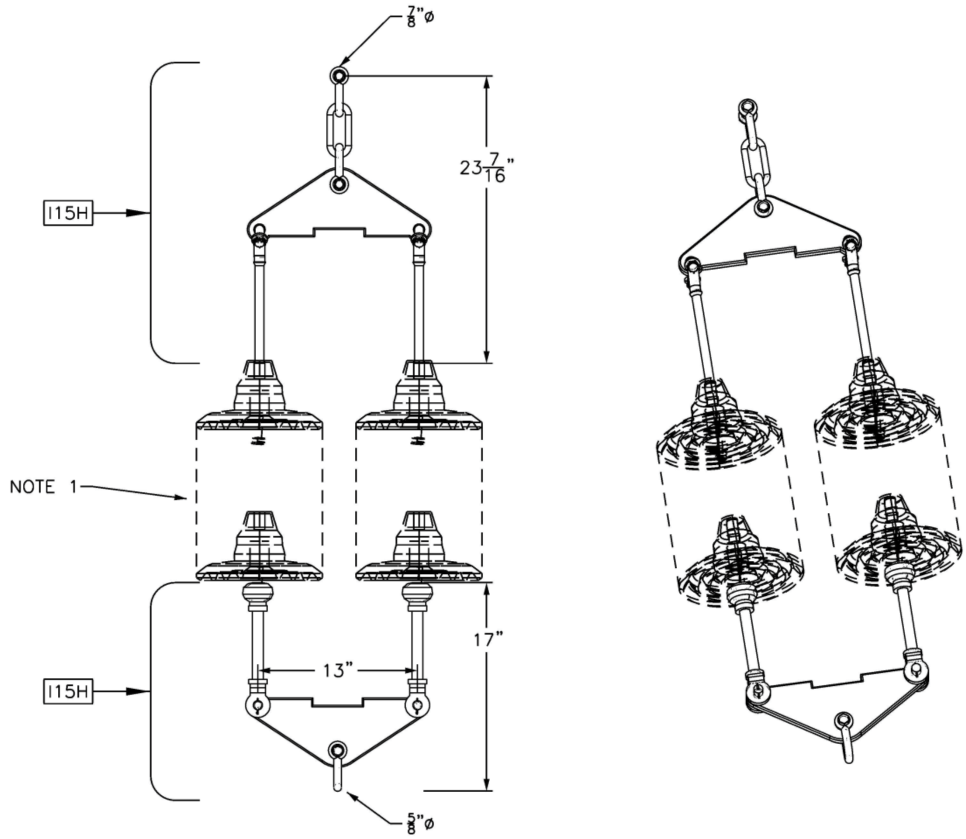
I15G	
2	ANCHOR SHACKLE–7/8"
1	CHAIN LINK
1	ANCHOR SHACKLE–3/4"
2	YOKE
2	BALL CLEVIS
2	SOCKET CLEVIS

NOTES:
1. INSULATORS (I8C) SHOWN IN DRAWING ARE NOT INCLUDED IN ASSEMBLY. INCUDE QUANTITY AS NEEDED PER VOLTAGE CHART.

21–42
MPR 6/21/17

DOUBLE INSULATOR ASSEMBLY - SUSPENSION

7/17 New Issue.



VOLTAGE	SUSPENSION INSULATOR ID
25KV	I8C(3)
35KV	I8C(3)
46KV	I8C(4)

I15H	
2	ANCHOR SHACKLE–7/8"
1	CHAIN LINK
1	ANCHOR SHACKLE–3/4"
2	YOKE
2	HOT LINE "Y" CLEVIS BALL
2	HOT LINE SOCKET CLEVIS

NOTES:
1. INSULATORS (I8C) SHOWN IN DRAWING ARE NOT INCLUDED IN ASSEMBLY. INCUDE QUANTITY AS NEEDED PER VOLTAGE CHART.

21–43
MPR 6/21/17

DOUBLE INSULATOR ASSEMBLY - DEADEND

21.10 Wood pole structure marking and labeling.

The type, quantity and nature of wood pole structure numbering, marking and labeling shall vary depending upon the location of the sub-transmission line.

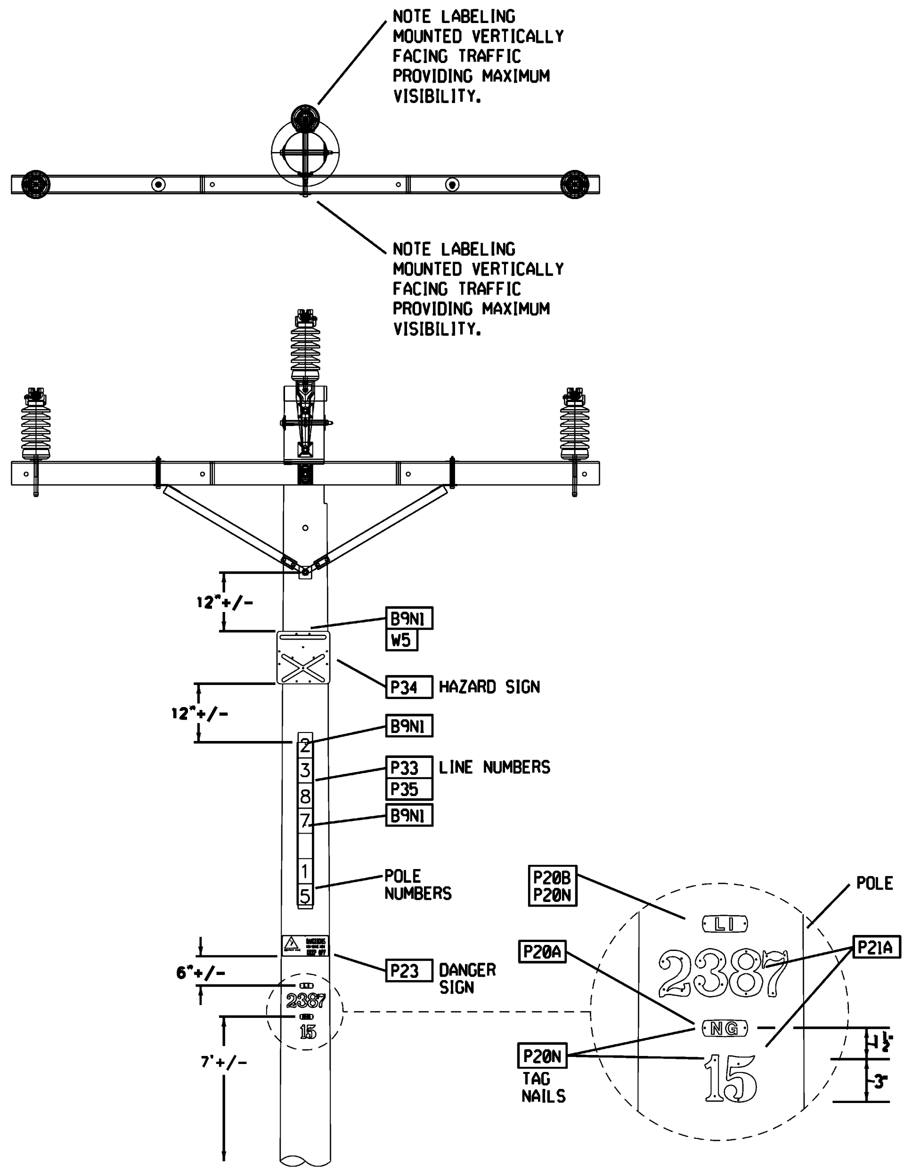
21.10.10 Right-of –way locations:

1. Aerial warning hazard signs are to be installed for conditions shown on pp 21-48 and 21-29.
2. Aerial structure numbers are to be installed on ever structure ending in ‘0’ (i.e. 10, 20, 30, etc), the 1st and last structures of the line or tap, and at road crossings.
3. Aerial line numbers are to be installed on both sides of the first and last structures of the line or tap.
4. Aerial line number channels shall be crimped top and bottom to secure number tiles.
5. Aerial line number channels hold 3 number tiles. They may be installed in tandem to allow for line numbers or structure numbers that contain more than 3 characters.
6. Danger signs shall be installed on both sides of the structure.
7. Ground line structure and line numbers shall be installed on both side of the structure at 7 feet +/- above grade.

21.10.20 Road Side Locations:

1. Only one set of ground line structure and line numbers facing the roadside are required.
2. Aerial warning signs, line or structure numbers may be installed on a case by case basis if deemed necessary.

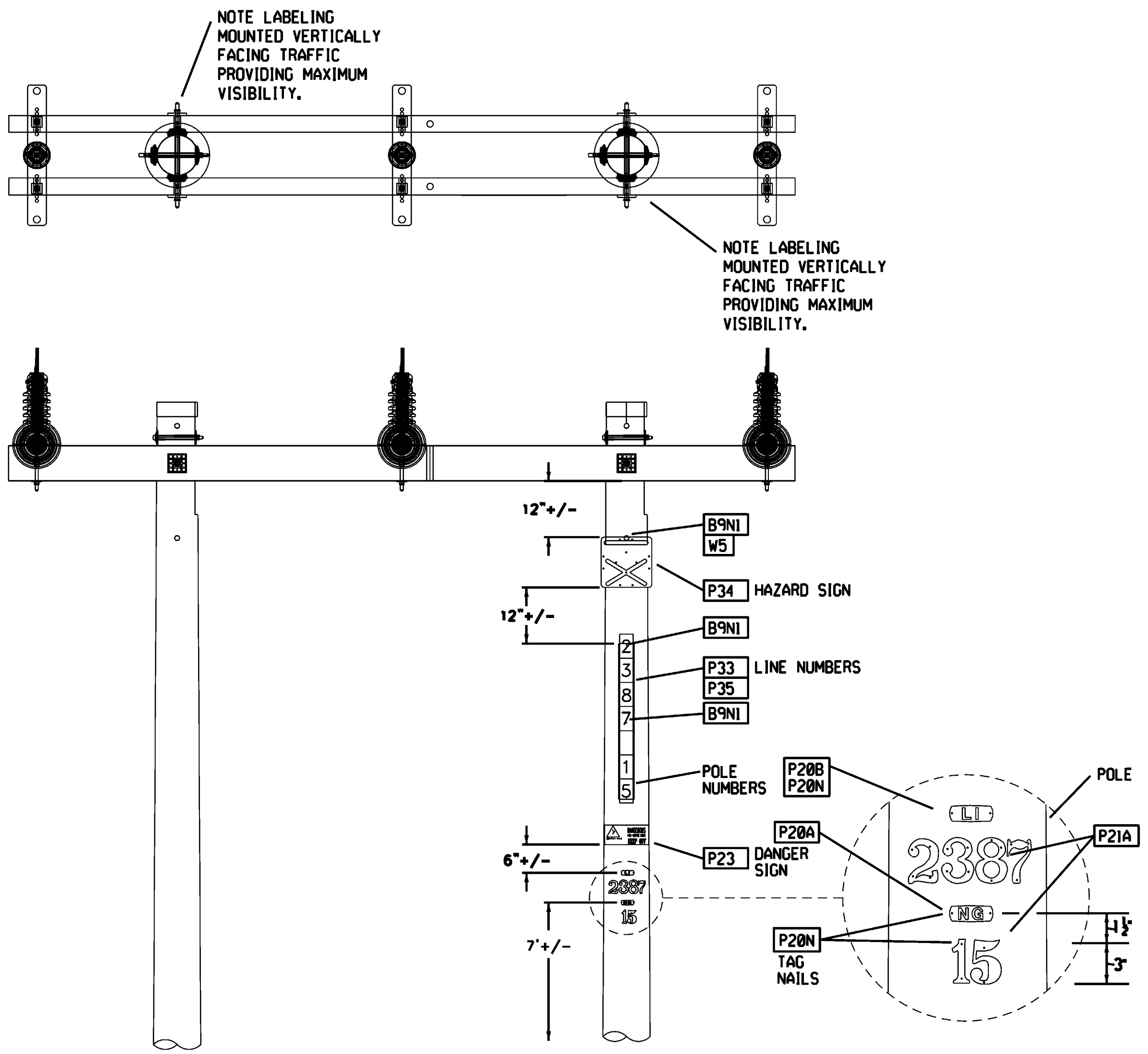
Supersedes 7/17 Issue – Drawing revision.



WOOD POLE STRUCTURE LABELING
SINGLE CIRCUIT, SINGLE POLE

21-45
MPR 6/30/20

WOOD POLE STRUCTURE LABELING, SINGLE POLE SINGLE CIRCUIT

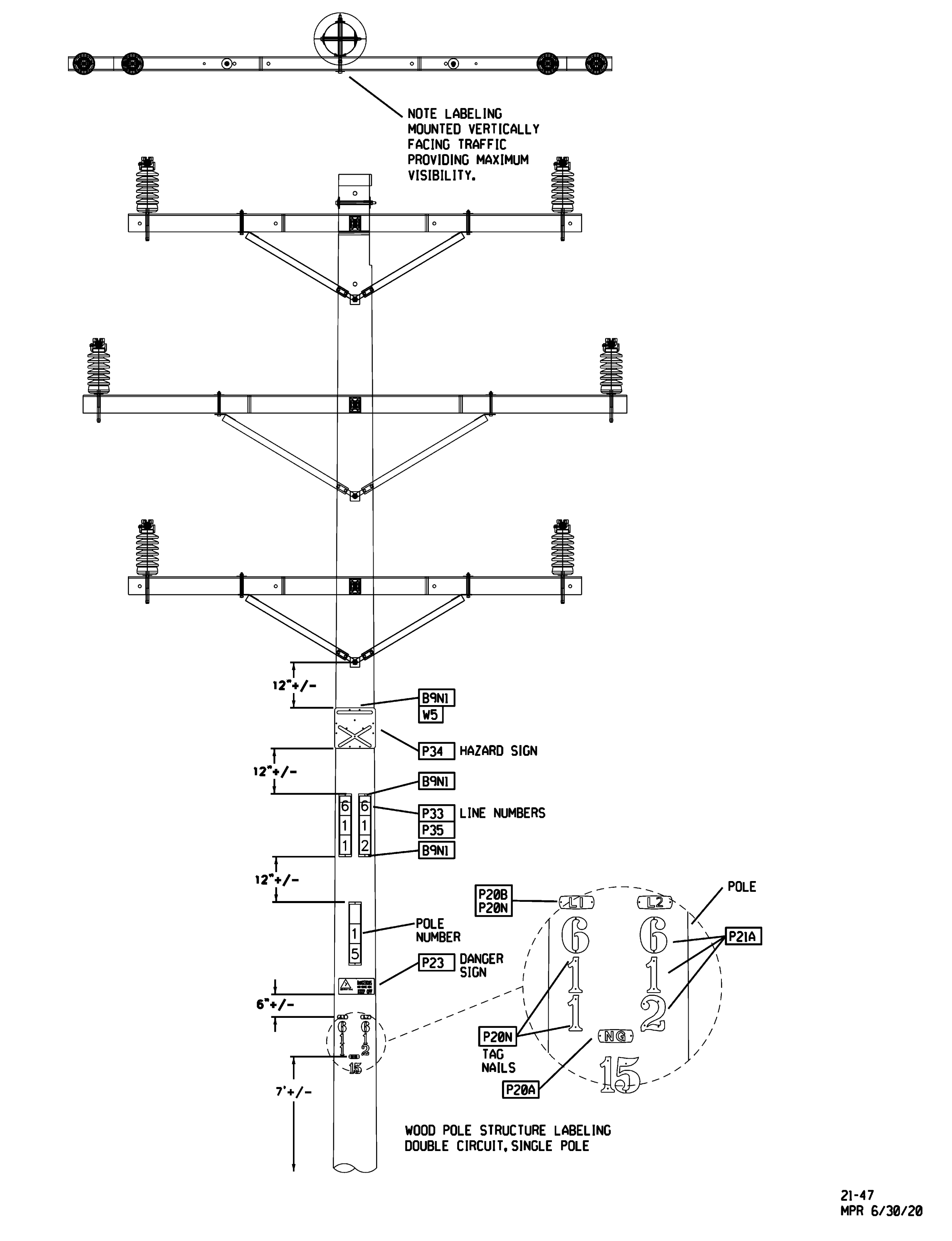


WOOD POLE STRUCTURE LABELING
SINGLE CIRCUIT, DOUBLE POLE

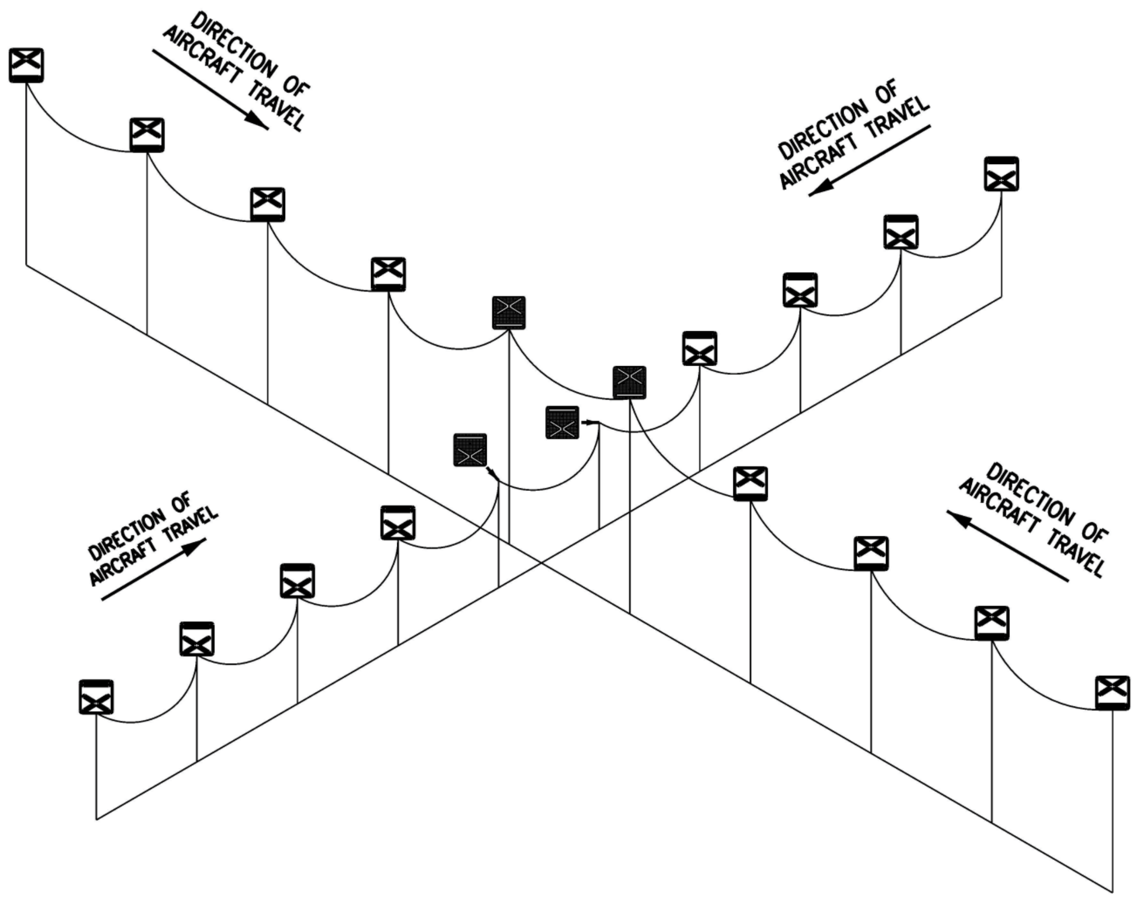
21-46
MPR 6/30/20

Supersedes 7/17 Issue – Drawing revision.

Supersedes 7/17 Issue – Drawing revision



WOOD POLE STRUCTURE LABELING, SINGLE POLE, DOUBLE CIRCUIT

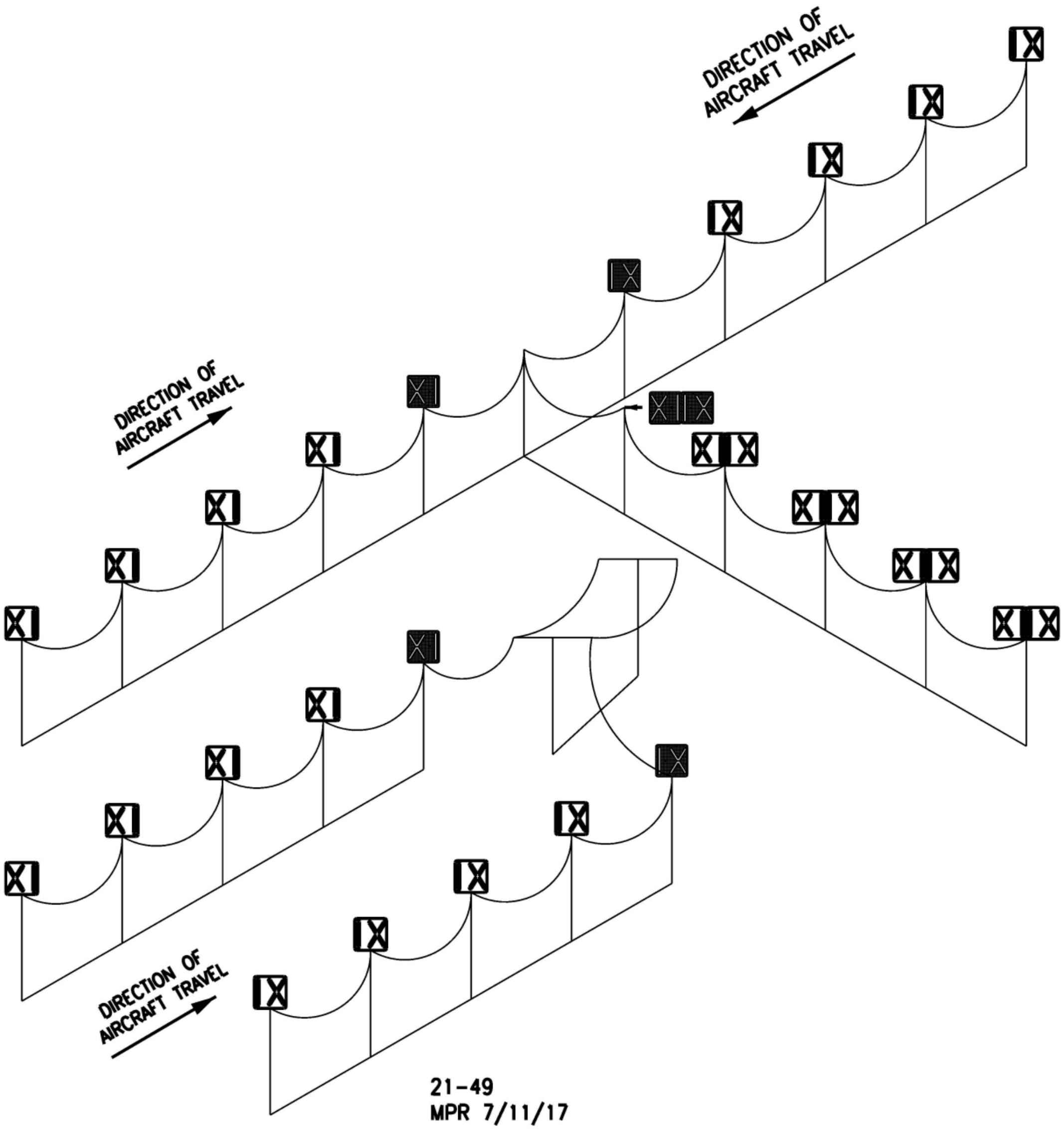


21-48
MPR 7/11/17

7/17 New Issue.

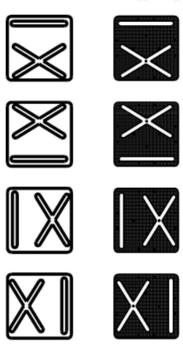
P34A	P34B	
YELLOW PRIMARY WARNING SIGN	RED LAST WARNING SIGN BEFORE HAZARD	
		USED TO INDICATE THAT THE UPCOMMING CROSSING LINE GOES OVER THE PATROLLED LINE.
		USED TO INDICATE THAT THE UPCOMMING CROSSING LINE GOES UNDER THE PATROLLED LINE.
		INDICATES THAT A TAP IS UPCOMING OR A SECOND CIRCUIT IS CONVERGING TO THE LEFT OF THE PATROLLED LINE.
		INDICATES THAT A TAP IS UPCOMING OR A SECOND CIRCUIT IS CONVERGING TO THE RIGHT OF THE PATROLLED LINE.

NOTE:
APPLY 5 SIGNS WITHIN A ½ MILE RADIUS OF CROSSING HAZARDS WHEN LINES HAVE MORE THAN 5 STRUCTURES WITHIN A ½ MILE RADIUS OF CROSSING. SIGNS SHALL BE PLACED AS EVENLY AS POSSIBLE. 4 YELLOW SIGNS AND 1 RED SIGN SHALL BE PLACED ON THE LAST STRUCTURE BEFORE THE HAZARD.



7/17 New Issue.

P34A	P34B
YELLOW PRIMARY WARNING SIGN	RED LAST WARNING SIGN BEFORE HAZARD



USED TO INDICATE THAT THE UPCOMMING CROSSING LINE GOES OVER THE PATROLLED LINE.

USED TO INDICATE THAT THE UPCOMMING CROSSING LINE GOES UNDER THE PATROLLED LINE.

INDICATES THAT A TAP IS UPCOMING OR A SECOND CIRCUIT IS CONVERGING TO THE LEFT OF THE PATROLLED LINE.

INDICATES THAT A TAP IS UPCOMING OR A SECOND CIRCUIT IS CONVERGING TO THE RIGHT OF THE PATROLLED LINE.

NOTE:
APPLY 5 SIGNS WITHIN A $\frac{1}{2}$ MILE RADIUS OF CROSSING HAZARDS WHEN LINES HAVE MORE THAN 5 STRUCTURES WITHIN A $\frac{1}{2}$ MILE RADIUS OF CROSSING. SIGNS SHALL BE PLACED AS EVENLY AS POSSIBLE. 4 YELLOW SIGNS AND 1 RED SIGN SHALL BE PLACED ON THE LAST STRUCTURE BEFORE THE HAZARD.

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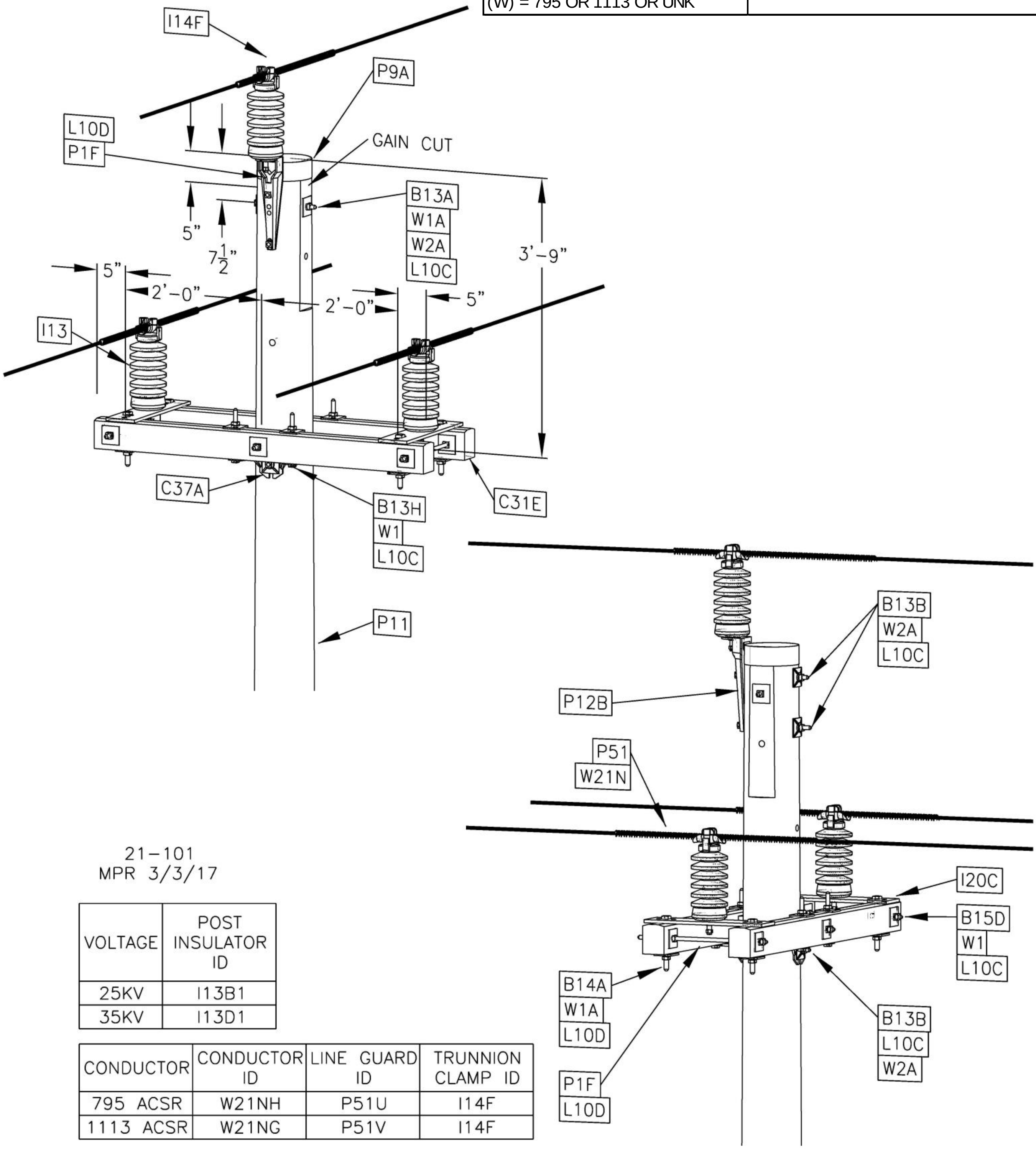
MU = @21-101(X)KVC(W)	SUB-T ACCOUNTING
MU = @21-101(X)KVC(W)DACCT	SUB-T WITH DISTRIBUTION ACCOUNTING
(X) = 25 OR 35	
(W) = 795 OR 1113 OR UNK	



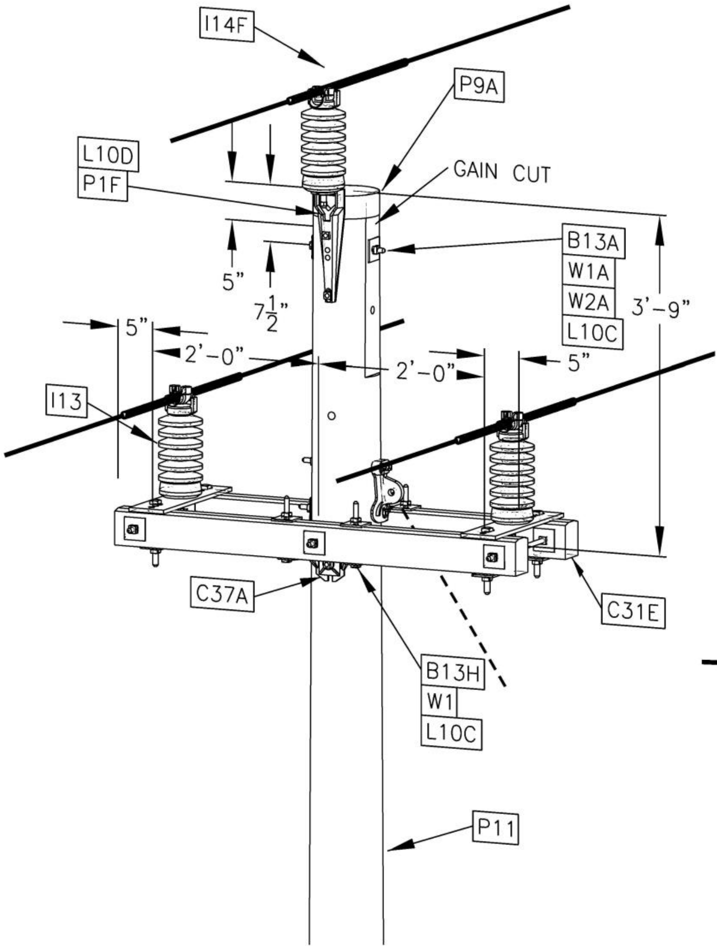
Supersedes 7/16 Issue – Drawing revision.

21-101
MPR 3/3/17

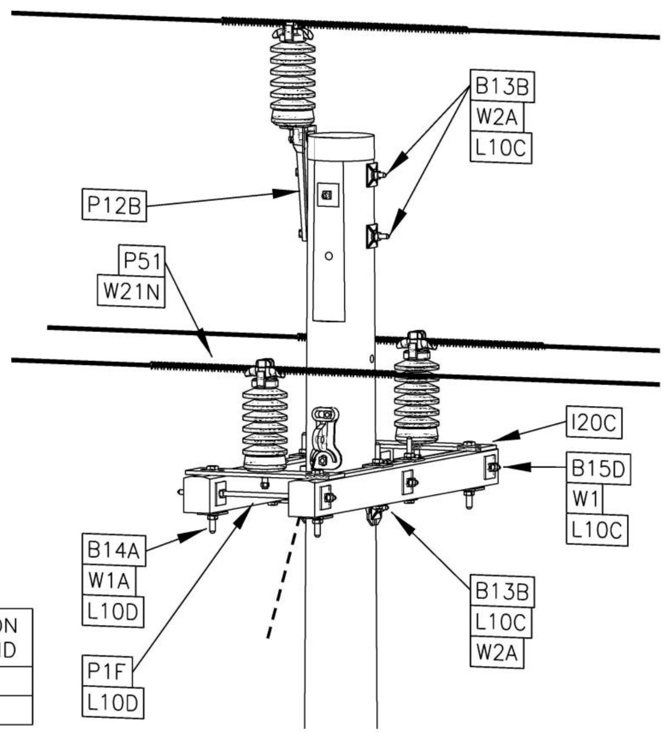
VOLTAGE	POST INSULATOR ID
25KV	I13B1
35KV	I13D1

CONDUCTOR	CONDUCTOR ID	LINE GUARD ID	TRUNNION CLAMP ID
795 ACSR	W21NH	P51U	I14F
1113 ACSR	W21NG	P51V	I14F

MU = @21-102(X)KVC(W)	SUB-T ACCOUNTING
MU = @21-102(X)KVC(W)DACCT	SUB-T WITH DISTRIBUTION ACCOUNTING
(X) = 25 OR 35	
(W) = 795 OR 1113 OR UNK	



SEE SECTION 3
FOR GUYING



Supersedes 7/16 Issue – Drawing revision.

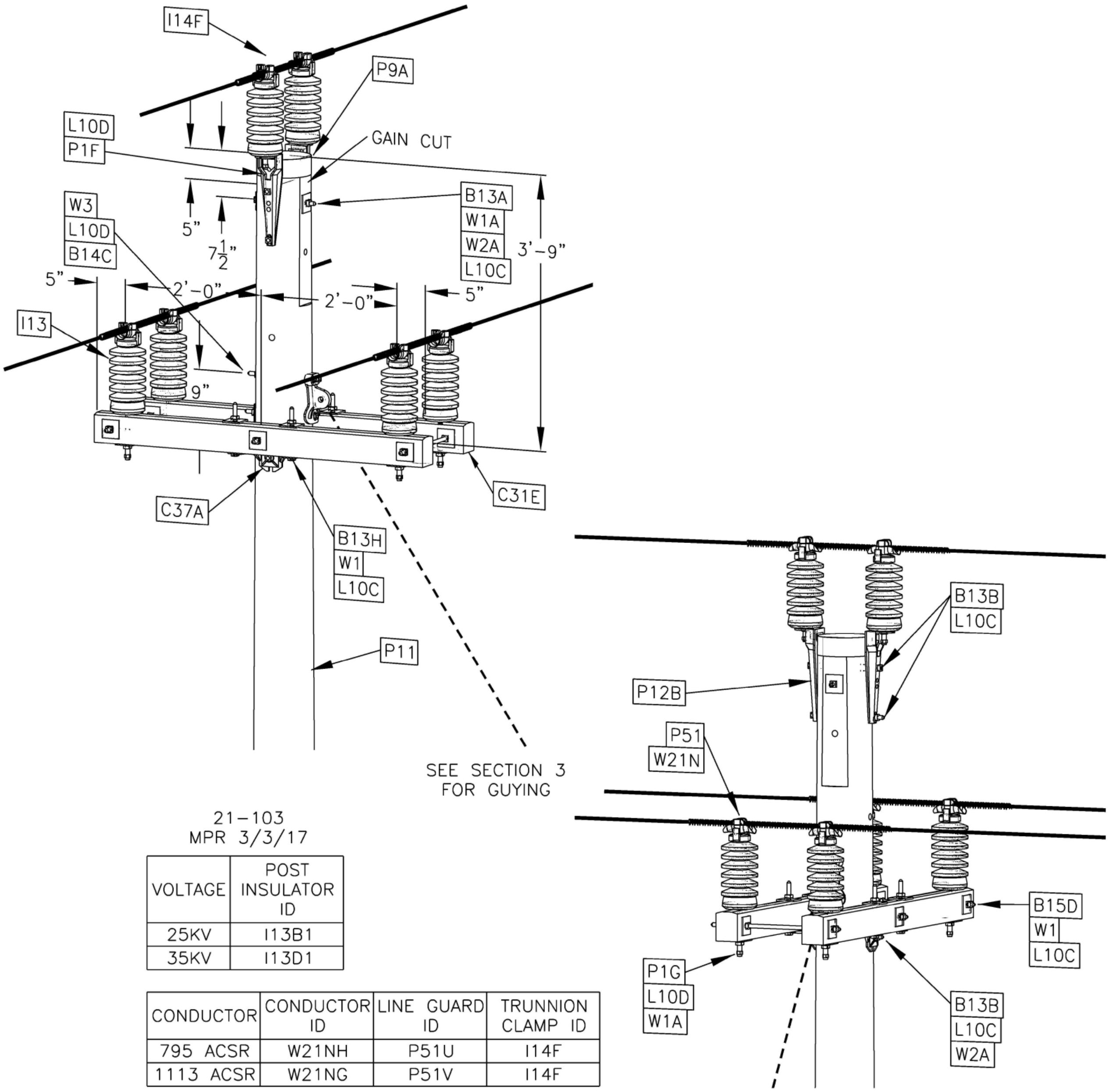
21–102
MPR 3/3/17

VOLTAGE	POST INSULATOR ID
25KV	I13B1
35KV	I13D1

CONDUCTOR	CONDUCTOR ID	LINE GUARD ID	TRUNNION CLAMP ID
795 ACSR	W21NH	P51U	I14F
1113 ACSR	W21NG	P51V	I14F

MU = @21-103(X)KVC(W)	SUB-T ACCOUNTING
MU = @21-103(X)KVC(W)DACCT	SUB-T WITH DISTRIBUTION ACCOUNTING
(X) = 25 OR 35	
(W) = 795 OR 1113 OR UNK	

Supersedes 7/16 Issue – Drawing revision.



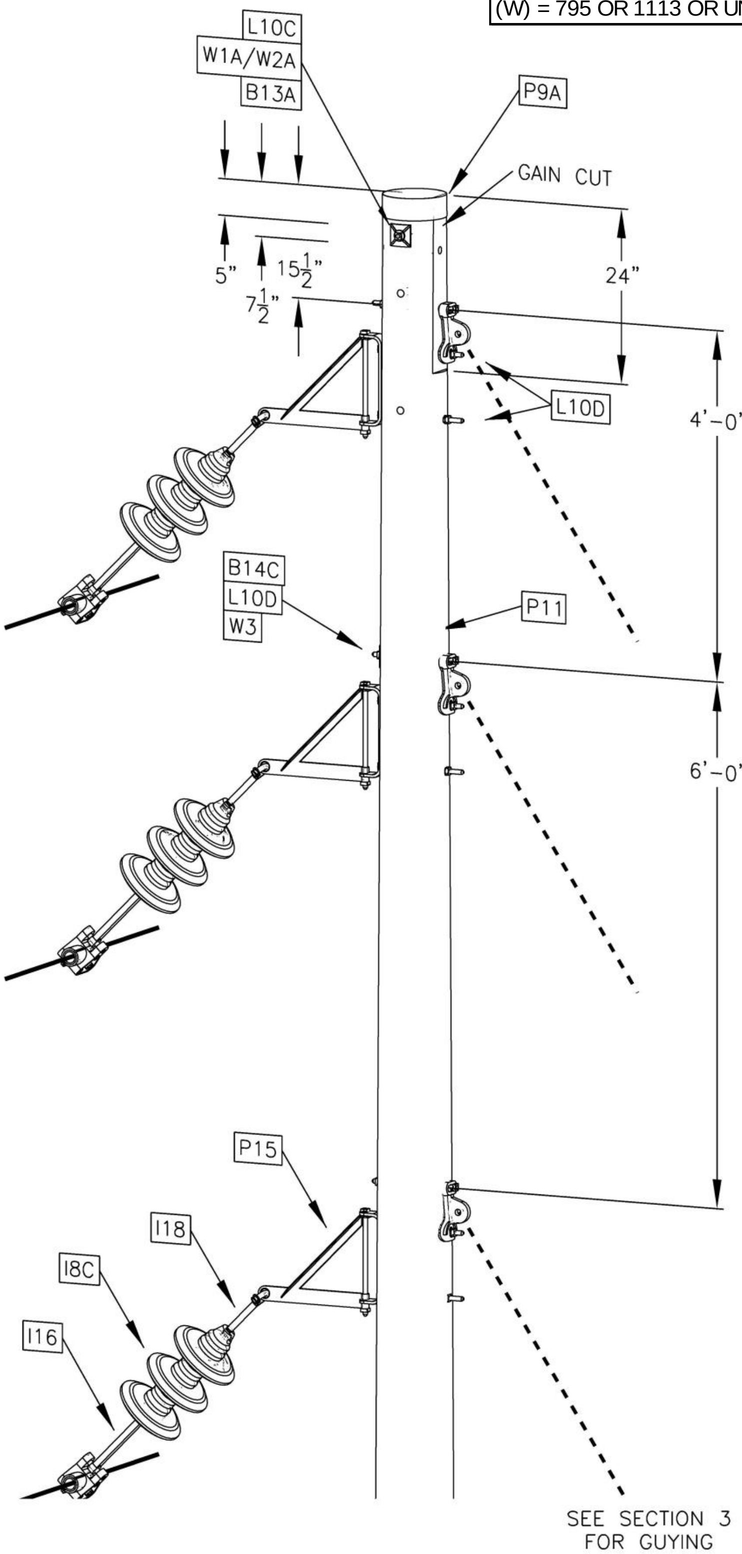
21–103
MPR 3/3/17

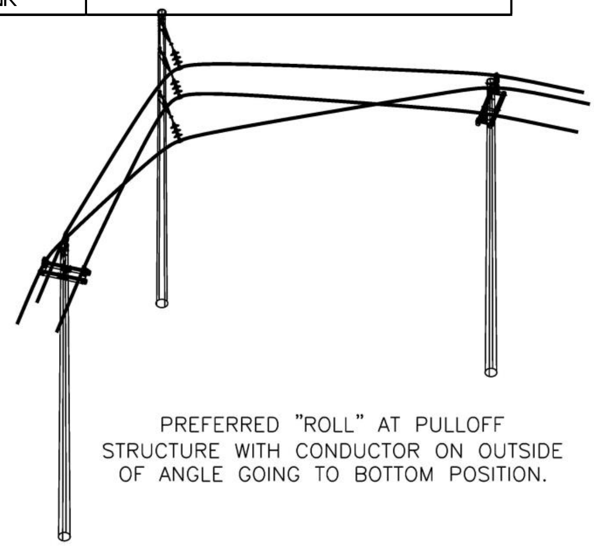
VOLTAGE	POST INSULATOR ID
25KV	I13B1
35KV	I13D1

CONDUCTOR	CONDUCTOR ID	LINE GUARD ID	TRUNNION CLAMP ID
795 ACSR	W21NH	P51U	I14F
1113 ACSR	W21NG	P51V	I14F

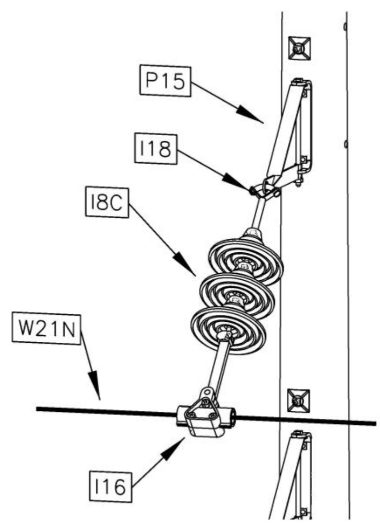
4 FOOT TRIANGLE, DOUBLE ARM, SINGLE INSULATOR, DADI-15 FOR 795 KCMIL AND 1113 KCMIL 25-35 KV

MU = @21-104(X)KVC(W)	SUB-T ACCOUNTING
MU = @21-104(X)KVC(W)DACCT	SUB-T WITH DISTRIBUTION ACCOUNTING
(X) = 25 OR 35	
(W) = 795 OR 1113 OR UNK	





PREFERRED "ROLL" AT PULLOFF STRUCTURE WITH CONDUCTOR ON OUTSIDE OF ANGLE GOING TO BOTTOM POSITION.



Supersedes 7/15 Issue – Drawing revision.

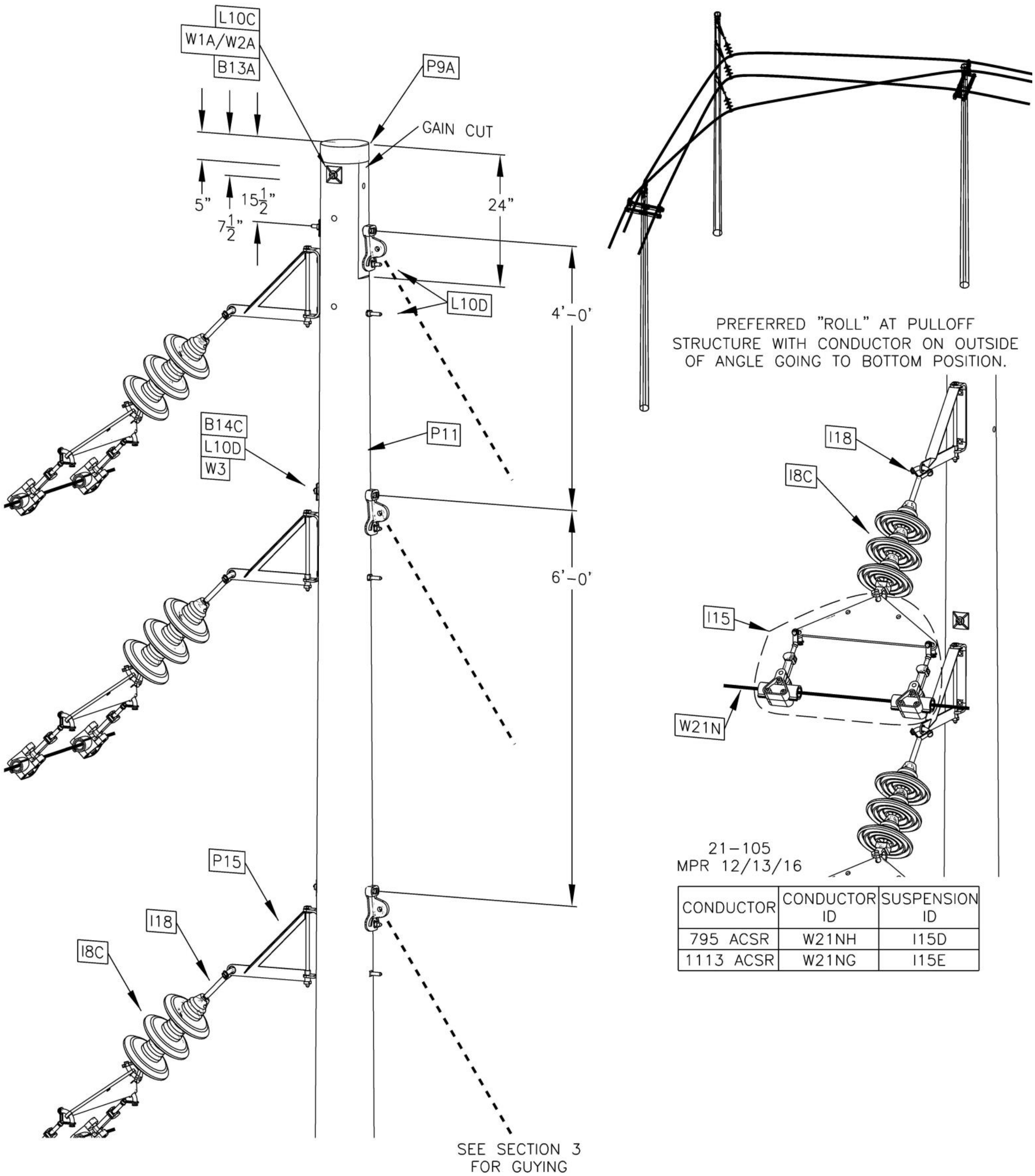
21–104
MPR 12/13/16

CONDUCTOR	CONDUCTOR ID	SUSPENSION ID
795 ACSR	W21NH	I16D
1113 ACSR	W21NG	I16C

SUSPENSION PULLOFF, SINGLE AGS UNIT, SPO-30 FOR 795 KCMIL AND 1113 KCMIL 25-35 KV

ISSUE	PAGE NUMBER		
7/16	21-104	OVERHEAD CONSTRUCTION STANDARD	ppl

MU = @21-105(X)KVC(W)	SUB-T ACCOUNTING
MU = @21-105(X)KVC(W)DACCT	SUB-T WITH DISTRIBUTION ACCOUNTING
(X) = 25 OR 35	
(W) = 795 OR 1113 OR UNK	



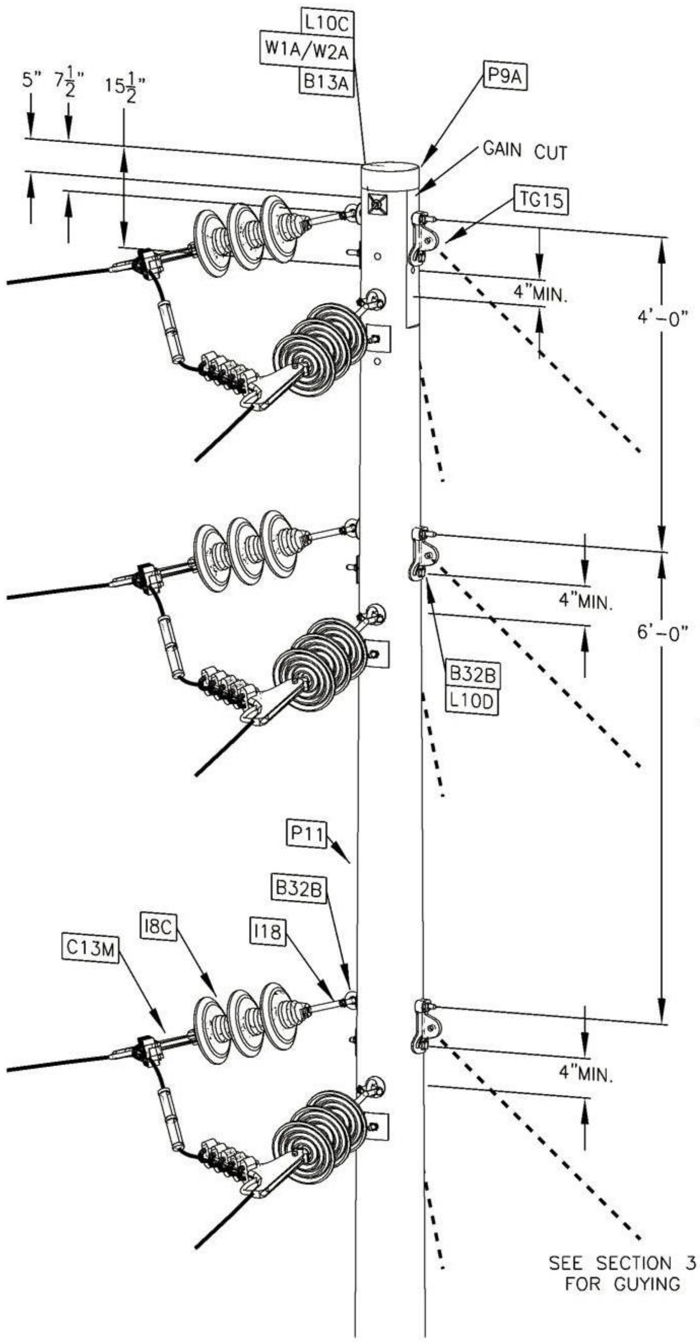
CONDUCTOR	CONDUCTOR ID	SUSPENSION ID
795 ACSR	W21NH	I15D
1113 ACSR	W21NG	I15E

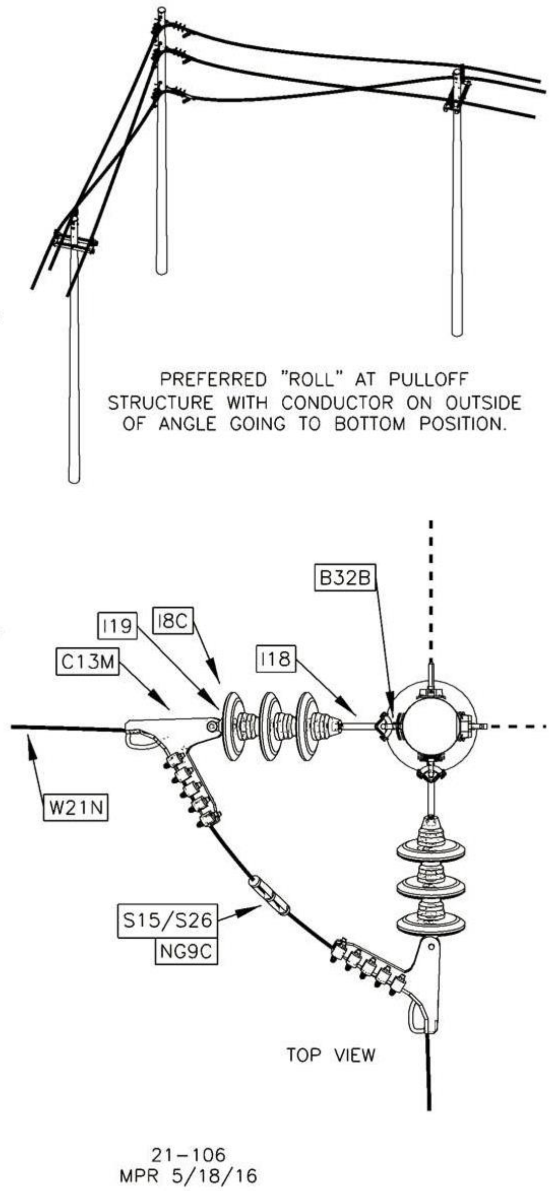
SUSPENSION PULLOFF, DOUBLE CGS UNIT, SPO-60
FOR 795 KCMIL AND 1113 KCMIL 25-35 KV

		PAGE NUMBER	ISSUE
nationalgrid	OVERHEAD CONSTRUCTION STANDARD	21-105	7/17

MU = @21-106(X)KVC(W)	DEADEND PULLOFF DEPO-90	SUB-T ACCOUNTING
MU = @21-106(X)KVC(W)DACCT	DEADEND PULLOFF DEPO-90	SUB-T WITH DISTRIBUTION ACCOUNTING
MU = @21-106(X)KVFDEC(W)	DEADEND FULL DEPO-90	SUB-T ACCOUNTING
MU = @21-106(X)KVFDEC(W)DACCT	DEADEND FULL DEPO-90	SUB-T WITH DISTRIBUTION ACCOUNTING
MU = @21-106(X)KVTC(W)	DEADEND TAP	SUB-T ACCOUNTING
MU = @21-106(X)KVTC(W)DACCT	DEADEND TAP	SUB-T WITH DISTRIBUTION ACCOUNTING
(X) = 25 OR 35		
(W) = 795 OR 1113 OR UNK		

Supersedes 7/16 Issue – Drawing revision.





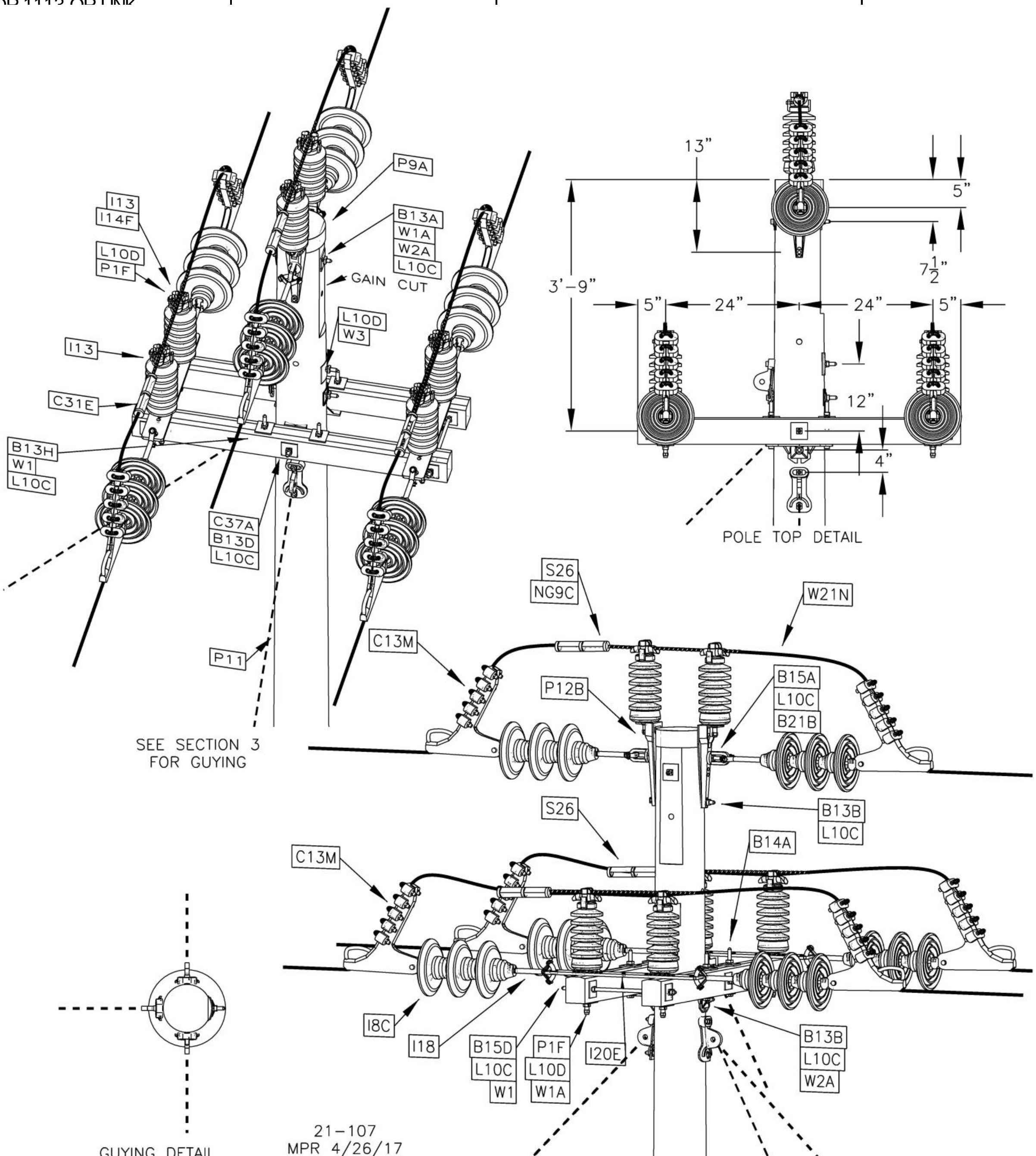
21–106
MPR 5/18/16

CONDUCTOR	CONDUCTOR ID	SPLICE ID
795 ACSR	W21NH	S26J
1113 ACSR	W21NG	S26K

DEADEND PULLOFF, DEPO-90
FOR 795 KCMIL AND 1113 KCMIL 25-35 KV

MU = @21-107(X)KVC(W)	DEADEND PULLOFF	SUB-T ACCOUNTING
MU = @21-107(X)KVC(W)DACCT	DEADEND PULLOFF	SUB-T WITH DISTRIBUTION ACCOUNTING
MU = @21-107(X)KVFDEC(W)	DEADEND FULL	SUB-T ACCOUNTING
MU = @21-107(X)KVFDEC(W)DACCT	DEADEND FULL	SUB-T WITH DISTRIBUTION ACCOUNTING
(X) = 25 OR 35		
(W) = 795 OR 1113 OR UNK		

Supersedes 7/16 Issue – Drawing revision.



Supersedes 7/15 Issue – Drawing revision.

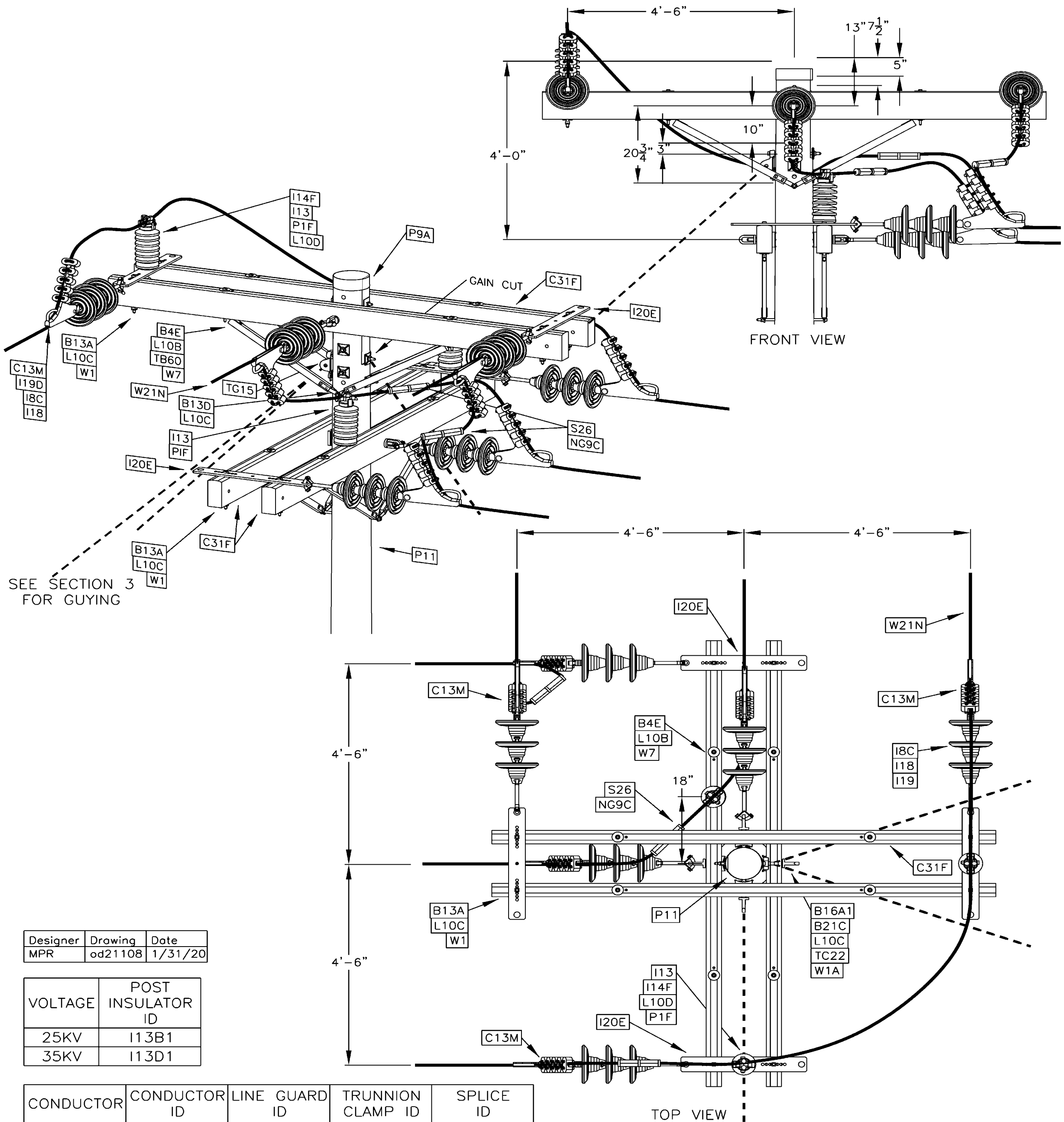
VOLTAGE	POST INSULATOR ID
25KV	I13B1
35KV	I13D1

CONDUCTOR	CONDUCTOR ID	LINE GUARD ID	TRUNNION CLAMP ID	SPLICE ID
795 ACSR	W21NH	P51U	I14F	S26J
1113 ACSR	W21NG	P51V	I14F	S26K

DEADEND PULLOFF, DEPO-90
FOR 795 KCMIL AND 1113 KCMIL 25-35 KV

MU = @21-108(X)KVC(W)	Buckarm DE Single Pole Ten Re	SUB-T ACCOUNTING
MU = @21-108(X)KVC(W)DACCT	Buckarm DE Single Pole Ten Re	SUB-T WITH DISTRIBUTION ACCOUNTING
MU = @21-108(X)KVFDEC(W)	Buckarm Deadend Full	SUB-T ACCOUNTING
MU = @21-108(X)KVFDEC(W)DACCT	Buckarm Deadend Full	SUB-T WITH DISTRIBUTION ACCOUNTING
(X) = 25 OR 35		
(W) = 795 OR 1113 OR UNK		

Supersedes 7/17 Issue – Drawing revision.



Designer	Drawing	Date
MPR	od21108	1/31/20

VOLTAGE	POST INSULATOR ID
25KV	I13B1
35KV	I13D1

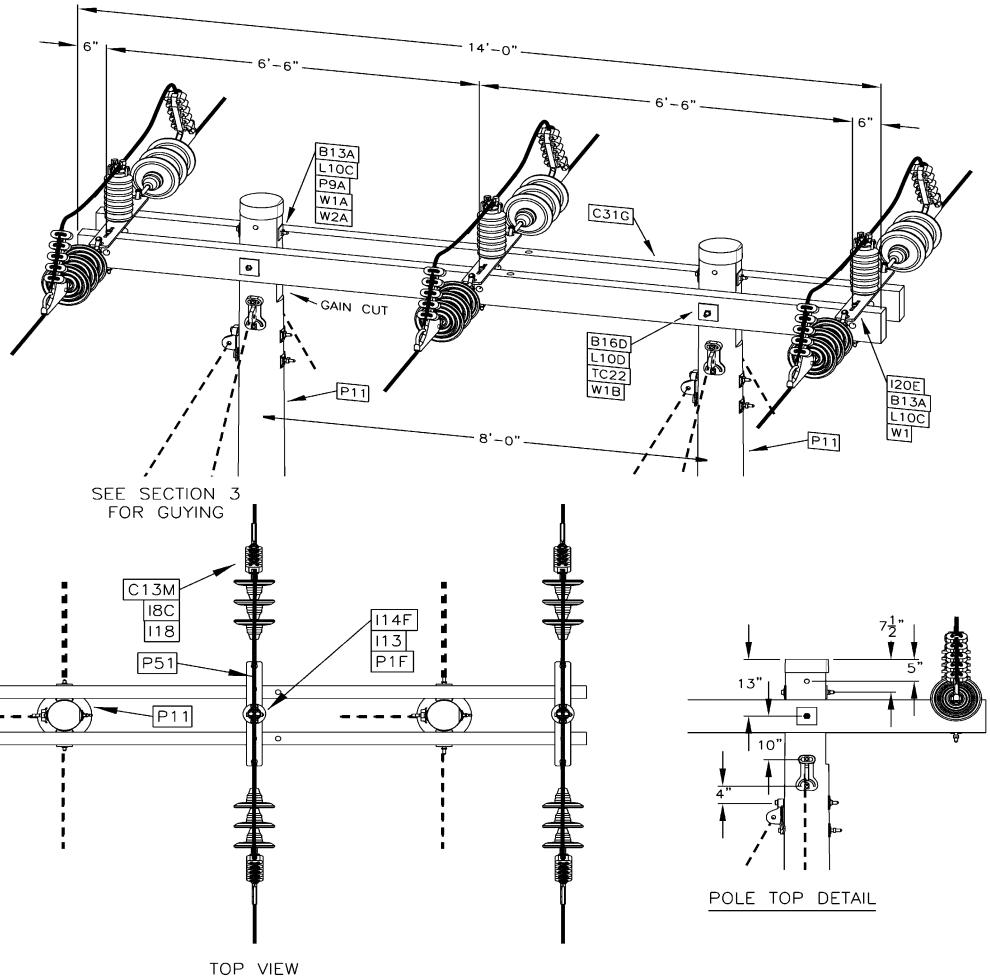
CONDUCTOR	CONDUCTOR ID	LINE GUARD ID	TRUNNION CLAMP ID	SPLICE ID
795 ACSR	W21NH	P51U	I14F	S26J
1113 ACSR	W21NG	P51V	I14F	S26K

BUCKARM DEADEND, SINGLE POLE, TENSION REDUCED - BADE FOR 795 KCMIL AND 1113 KCMIL 25-35 KV

ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/20	21-108		

MU = @21-113(X)KVC(W)	Buckarm DE Single Pole Ten Reduced Bade	SUB-T ACCOUNTING
MU = @21-113(X)KVC(W)DACCT	Buckarm DE Single Pole Ten Reduced Bade	SUB-T WITH DISTRIBUTION ACCOUNTING
(X) = 25 OR 35		
(W) = 795 OR 1113 OR UNK		

Supersedes 7/17 Issue – Drawing revision.



VOLTAGE	POST INSULATOR ID
25KV	I13B1
35KV	I13D1

CONDUCTOR	CONDUCTOR ID	LINE GUARD ID	TRUNNION CLAMP ID
795 ACSR	W21NH	P51U	I14F
1113 ACSR	W21NG	P51V	I14F

Designer	Drawing	Date
MPR	od21113	1/31/20

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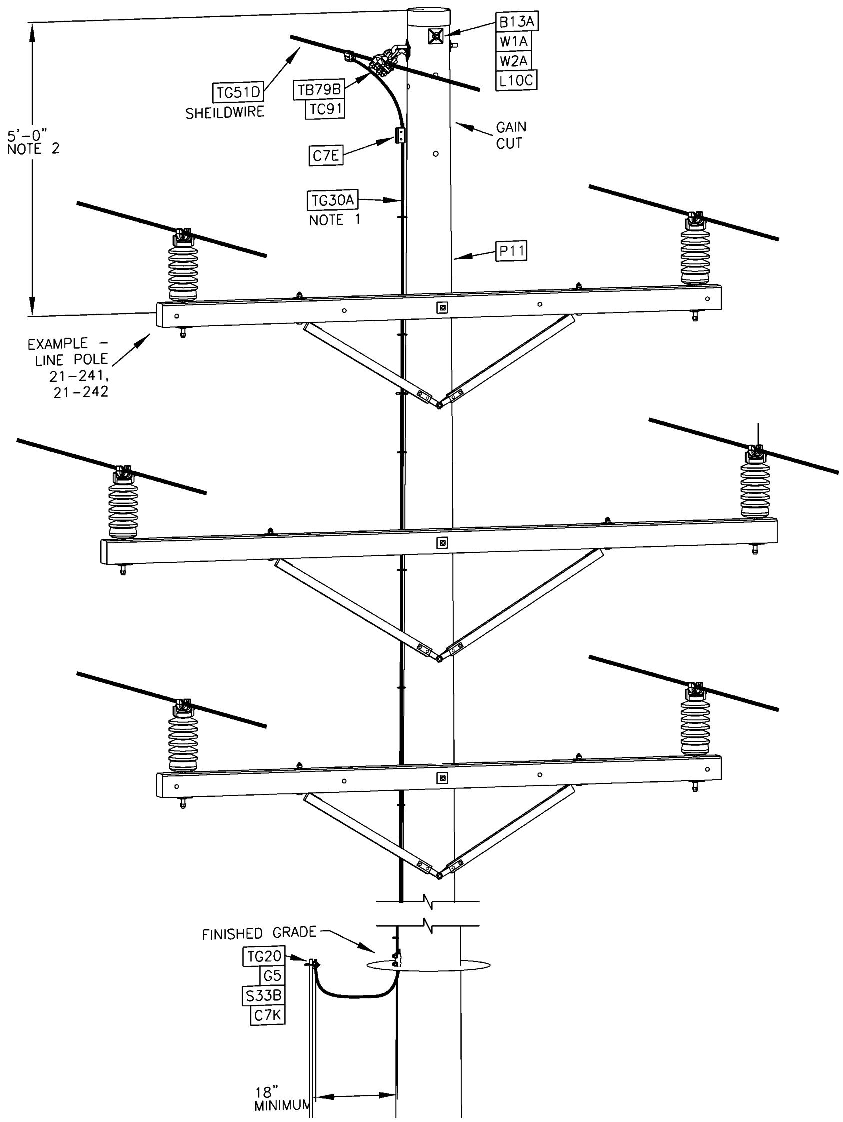
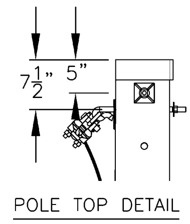




Supersedes 7/18 Issue – Drawing revision

NOTES:

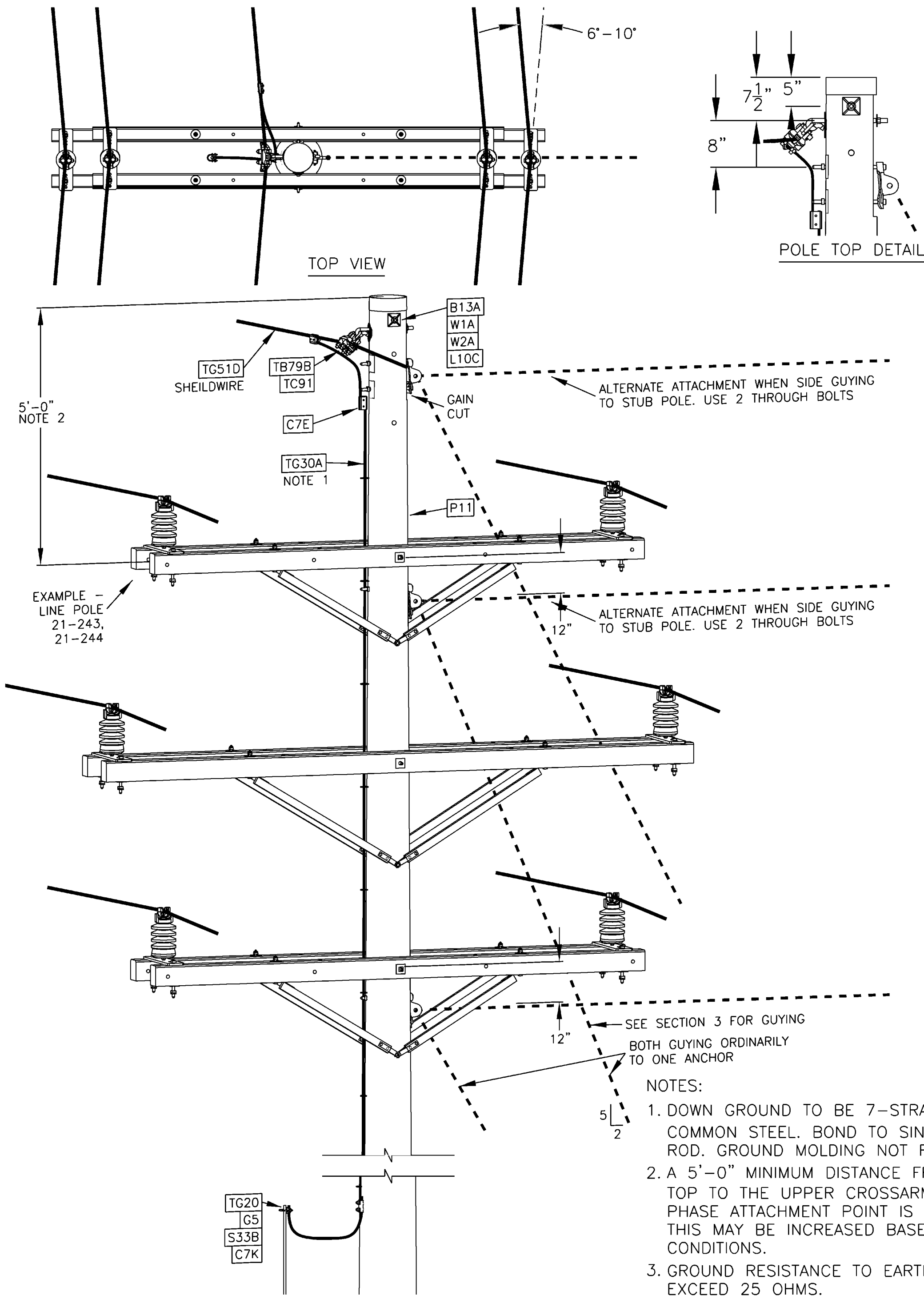
1. DOWN GROUND TO BE 7-STRANDED ⅜ COMMON STEEL. BOND TO SINGLE GROUND ROD. GROUND MOLDING NOT REQUIRED.
2. A 5'-0" MINIMUM DISTANCE FROM THE POLE TOP TO THE UPPER CROSSARM OR UPPER PHASE ATTACHMENT POINT IS RECOMMENDED. THIS MAY BE INCREASED BASED ON FIELD CONDITIONS.
3. ALL GUYS SHALL BE INSULATED.

Designer	Drawing	Date
MPR	od21300	4/20/19

25kV, 35kV, 46kV – SHIELD WIRE, SUSPENSION, TANGENT

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	21-300	7/19

Supersedes 7/18 Issue – Drawing revision



NOTES:

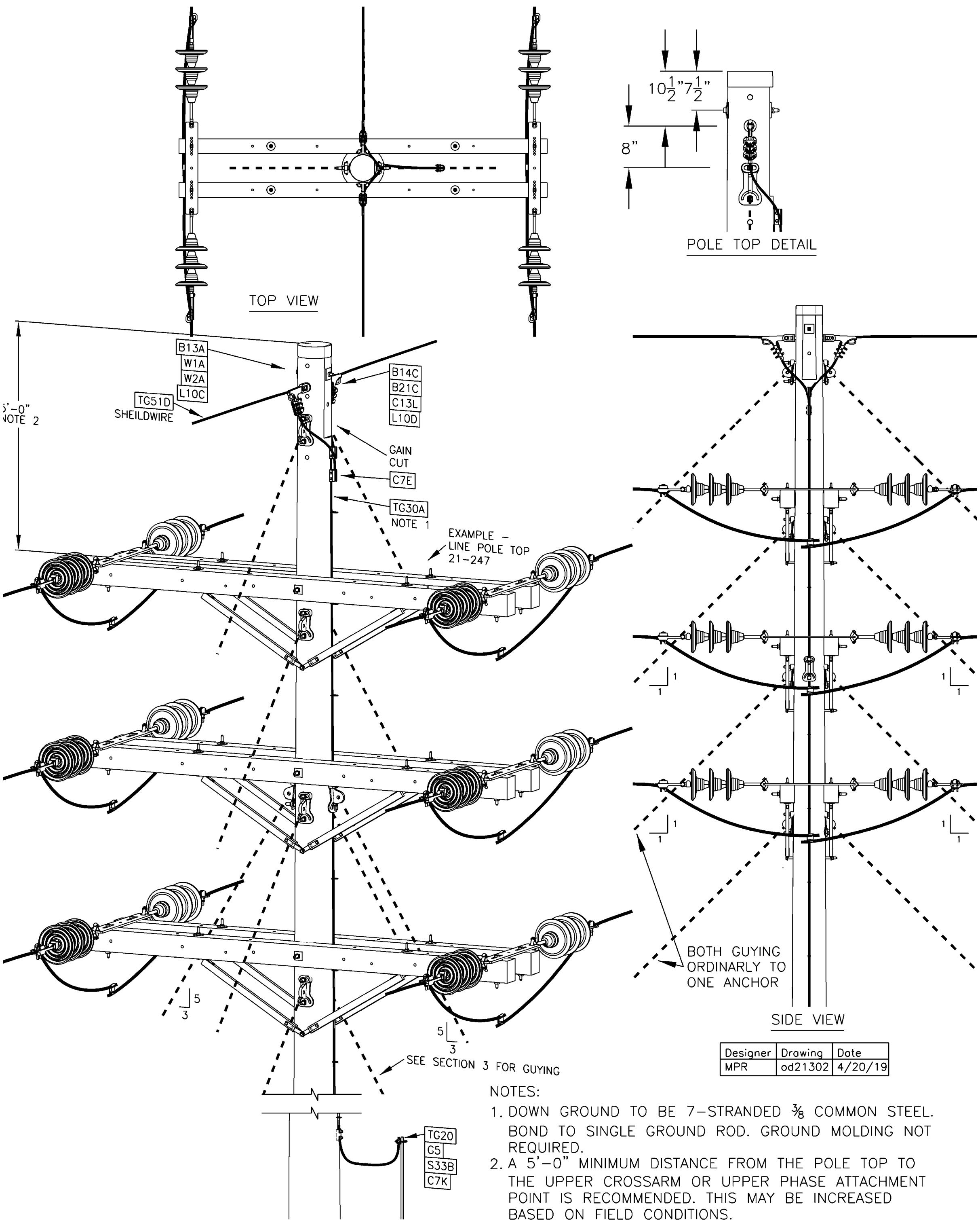
1. DOWN GROUND TO BE 7–STRANDED ⅜ COMMON STEEL. BOND TO SINGLE GROUND ROD. GROUND MOLDING NOT REQUIRED.
2. A 5'–0" MINIMUM DISTANCE FROM THE POLE TOP TO THE UPPER CROSSARM OR UPPER PHASE ATTACHMENT POINT IS RECOMMENDED. THIS MAY BE INCREASED BASED ON FIELD CONDITIONS.
3. GROUND RESISTANCE TO EARTH SHALL NOT EXCEED 25 OHMS.
4. ALL GUYS SHALL BE INSULATED.

Designer	Drawing	Date
MPR	od21301	4/20/19

Supersedes 7/18 Issue – Drawing revision

25kV, 35kV, 46kV –SHIELD WIRE, SUSPENSION, 1 – 10 DEGREE LINE ANGLE

Supersedes 7/18 Issue – Updated drawing.



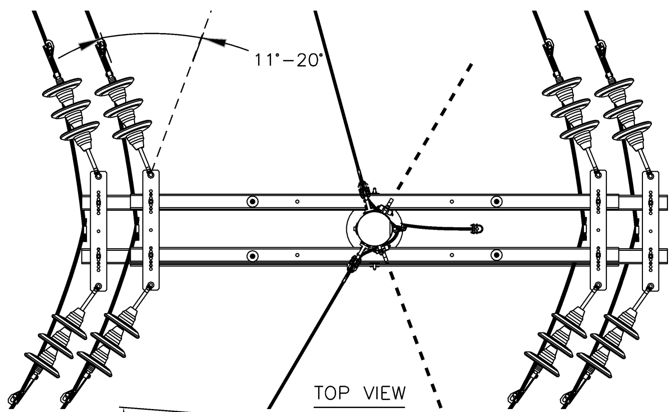
Designer	Drawing	Date
MPR	od21302	4/20/19

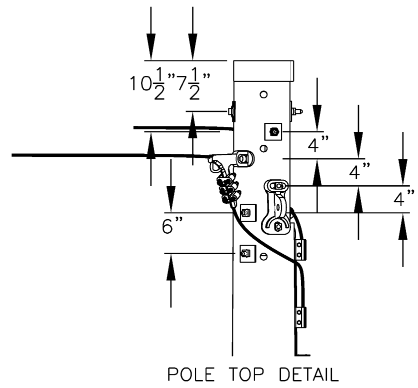
NOTES:

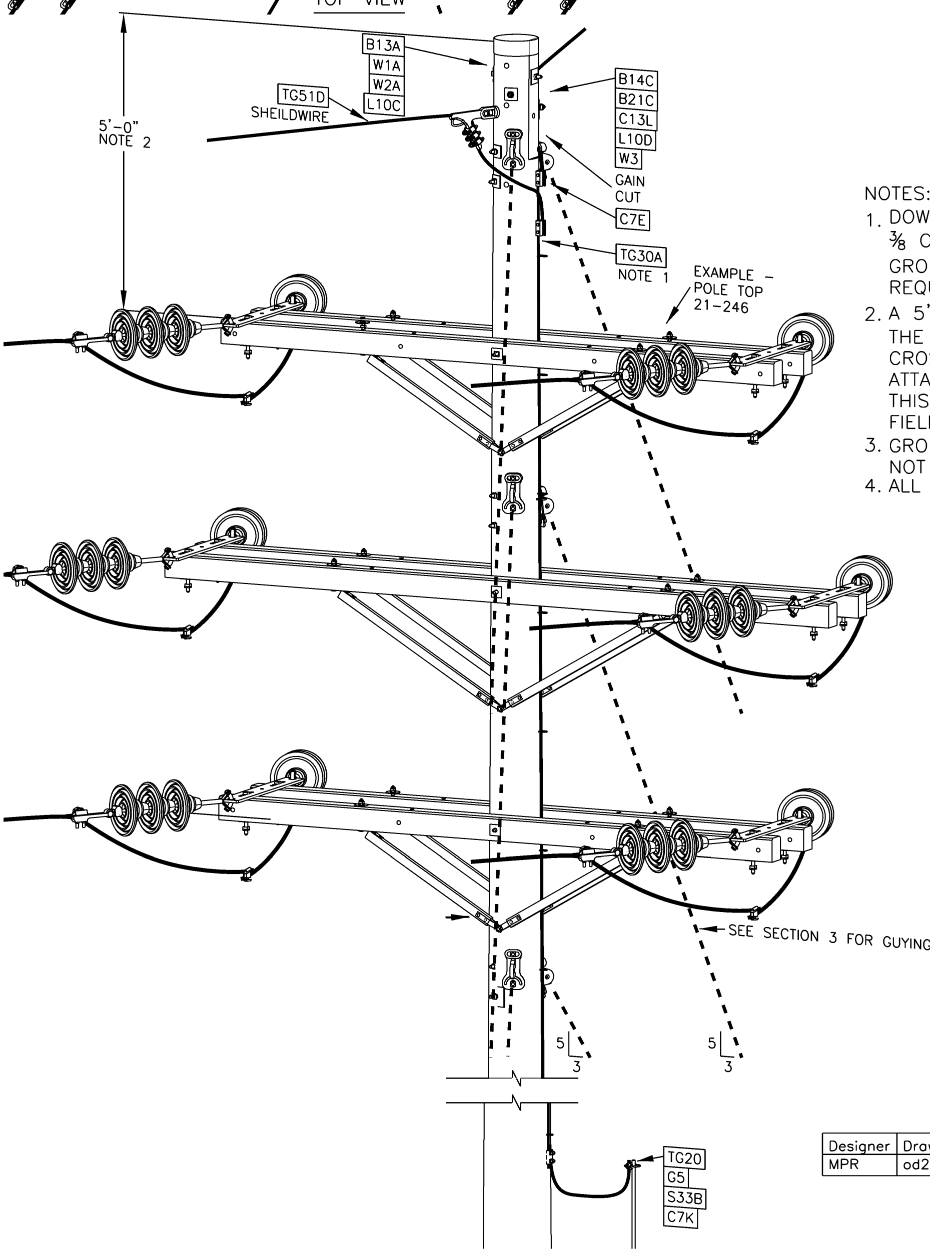
1. DOWN GROUND TO BE 7–STRANDED ⅜ COMMON STEEL. BOND TO SINGLE GROUND ROD. GROUND MOLDING NOT REQUIRED.
2. A 5'-0" MINIMUM DISTANCE FROM THE POLE TOP TO THE UPPER CROSSARM OR UPPER PHASE ATTACHMENT POINT IS RECOMMENDED. THIS MAY BE INCREASED BASED ON FIELD CONDITIONS.
3. GROUND RESISTANCE TO EARTH SHALL NOT EXCEED 25 OHMS.
4. ALL GUYS SHALL BE INSULATED.

25kV, 35kV, 46kV – SHIELD WIRE, STRAIN, TANGENT

		PAGE NUMBER	ISSUE
ppl	OVERHEAD CONSTRUCTION STANDARD	21-302	7/19







NOTES:

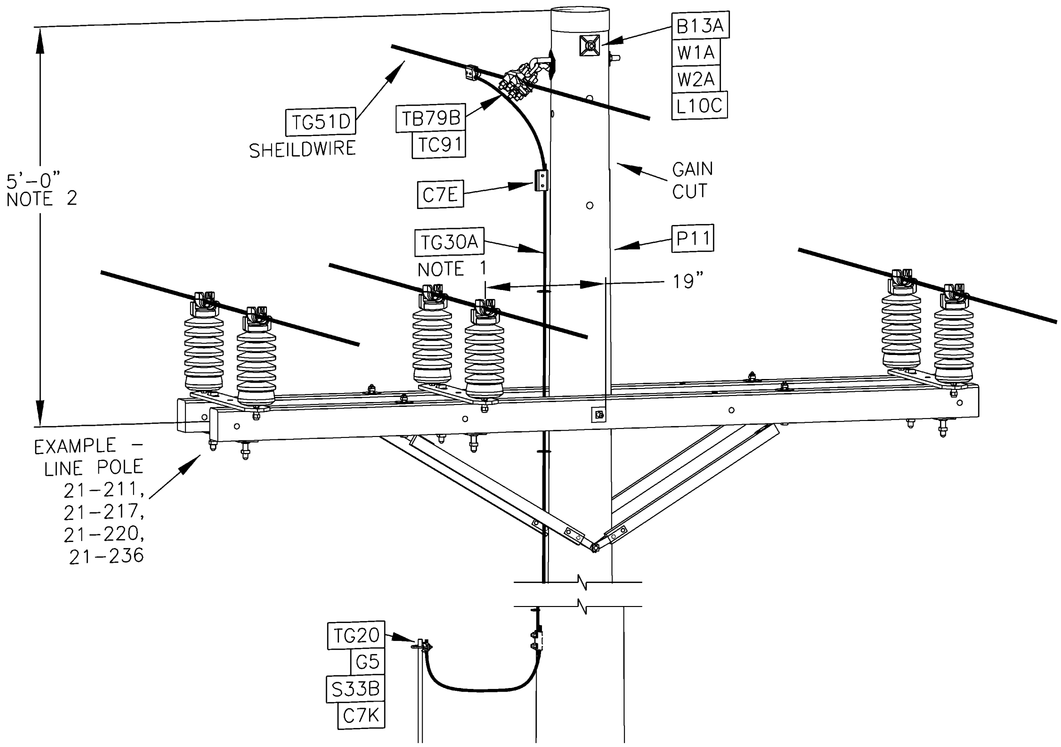
1. DOWN GROUND TO BE 7–STRANDED ⅜ COMMON STEEL. BOND TO SINGLE GROUND ROD. GROUND MOLDING NOT REQUIRED.
2. A 5'–0" MINIMUM DISTANCE FROM THE POLE TOP TO THE UPPER CROSSARM OR UPPER PHASE ATTACHMENT POINT IS RECOMMENDED. THIS MAY BE INCREASED BASED ON FIELD CONDITIONS.
3. GROUND RESISTANCE TO EARTH SHALL NOT EXCEED 25 OHMS.
4. ALL GUYS SHALL BE INSULATED.

Supersedes 7/19 Issue – Drawing revision.

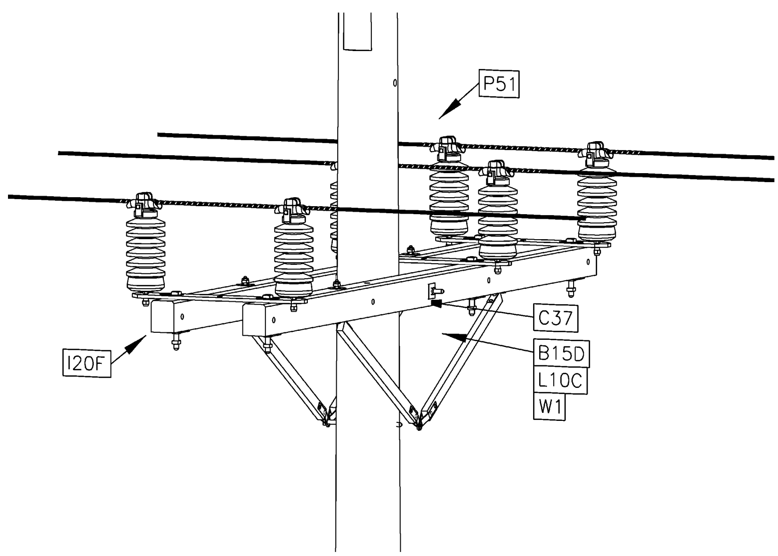
Designer	Drawing	Date
MPR	od21303	1/31/20

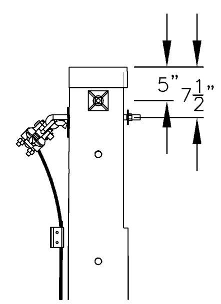
25kV, 35kV, 46kV – SHIELD WIRE, STRAIN, 11 – 20 DEGREE LINE ANGLE

ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/20	21-303		



7/19 - New issue



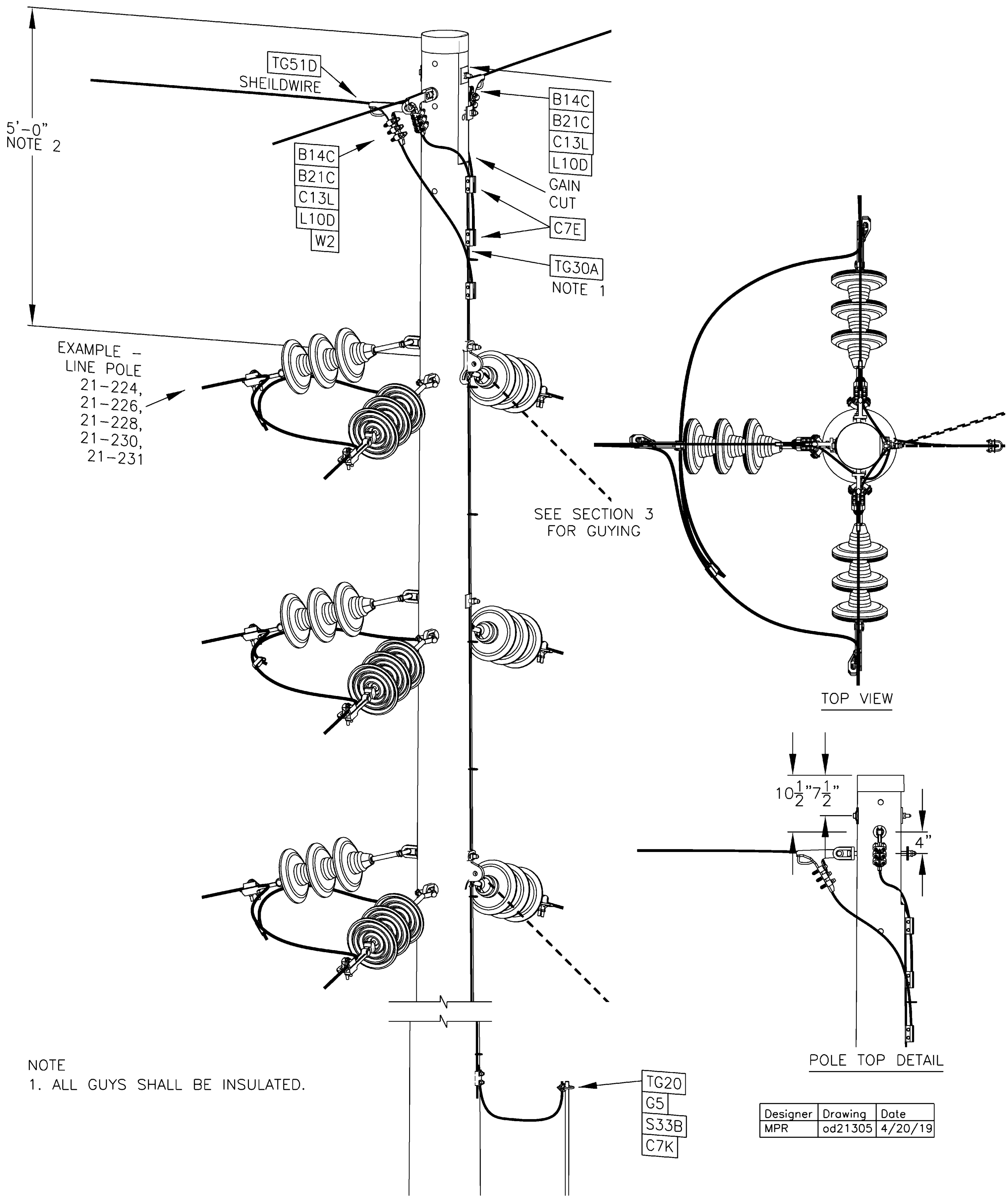


POLE TOP DETAIL

Designer	Drawing	Date
MPR	od21304	4/20/19

NOTE
1. ALL GUYS SHALL BE INSULATED.

25kV, 35kV, 46kV Shield Wire, Double Arm, 0 – 2 Degree Line Angle



NOTE
1. ALL GUYS SHALL BE INSULATED.

7/19 - New issue.

25kV, 35kV, 46kV – SHIELD WIRE, SINGLE POLE, VERTICLE,SINGLE CIRCUIT TEE TAP			
ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/19	21-305		

Standard Overhead Sub-Transmission Conductors

Std. Item:	W21NG
Item ID:	5941814[E]
CU:	C1113ASSTBRNE

PHYSICAL PROPERTIES	
R.B.S.	39,100 lbs.
C.S.A.	0.9854 sq. in.
R. (@ 25˚C)	0.0161 Ω / 1000’
R. (@ 75˚C)	0.0191 Ω / 1000’
CONDUCTOR DIAMETER	1.293”
WEIGHT	1430 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.7634 Lb/Ft
VERTICAL	2.546 Lb/Ft
TOTAL	2.958 Lb/Ft
SWING	24.33˚

CURRENT CARRYING CAPACITIES		
SUMMER (37.7˚C)	CONDUCTOR TEMPERATURE	WINTER (10˚C)
276	122˚F/50˚C	1202
1111	176˚F/80˚C	1573
1393	212˚F/100˚C	1763
1803	284˚F/140˚C	2073

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	2672	1772	1394	1162	2461	1810	1499	1287	2318	1837	1578	1389	2208	1857	1639	1471
ACTUAL SPAN (FEET)																
50	2	3	4	5	2	3	4	4	2	3	3	4	2	3	3	4
60	3	4	6	7	3	4	5	6	3	4	5	6	3	4	5	5
70	4	6	8	9	4	6	7	8	5	6	7	8	5	6	6	7
80	5	8	10	12	6	8	9	11	6	7	9	10	6	7	8	9
90	7	10	12	15	7	10	12	14	8	9	11	13	8	9	11	12
100	8	12	15	18	9	12	14	17	9	12	14	15	10	12	13	15
110	10	15	19	22	11	14	17	20	11	14	16	19	12	14	16	18
120	12	17	22	27	13	17	21	24	13	17	20	22	14	17	19	21
130	14	20	26	31	15	20	24	28	16	20	23	26	16	20	22	25
140	16	24	30	36	17	23	28	33	18	23	27	30	19	23	26	29
150	18	27	35	42	20	27	32	38	21	26	31	35	22	26	29	33
160	21	31	39	47	22	30	37	43	24	30	35	40	25	30	34	37
170	23	35	45	53	25	34	41	48	27	34	39	45	28	33	38	42
180	26	39	50	60	28	38	46	54	30	38	44	50	32	37	42	47
190	29	44	56	67	31	43	52	60	33	42	49	56	35	42	47	53
200	32	48	62	74	35	47	57	67	37	47	54	62	39	46	52	58
210	35	53	68	82	38	52	63	74	41	52	60	68	43	51	58	64
220	39	59	75	90	42	57	69	81	45	57	66	75	47	56	63	71
230	43	64	82	98	46	63	76	88	49	62	72	82	51	61	69	77
240	46	70	89	107	50	68	83	96	53	67	78	89	56	67	75	84
250	50	76	96	116	55	74	90	104	58	73	85	97	61	72	82	91
260	54	82	104	125	59	80	97	113	63	79	92	105	66	78	89	99
270	59	88	112	135	64	87	105	122	68	85	99	113	71	84	96	107
280	63	95	121	145	68	93	112	131	73	92	107	121	76	91	103	115
290	68	102	130	156	73	100	121	141	78	98	115	130	82	97	110	123
300	72	109	139	167	79	107	129	150	83	105	123	139	88	104	118	132

****** Simulated with a maximum tension of 4000 lbs. ******

CU:	C1113ASSTBRNE

	FINAL SAG TABLE									
	LOADING (UNLOADED CONDITIONS)									
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**212**	**257**	**284**
TEMP. ˚C	**-20**	**0**	**15**	**32**	**50**	**70**	**80**	**100**	**125**	**140**
DEAD END SPAN (FEET)										
50	1	4	7	9	10	11	12	13	14	15
75	4	8	12	14	16	18	19	21	22	24
100	8	13	18	21	23	26	27	29	31	33
125	13	20	25	29	32	34	36	38	41	47
150	21	28	33	38	41	44	46	48	51	53
175	30	37	43	48	52	55	57	60	63	65
200	40	47	54	60	63	67	69	72	76	78
225	51	59	66	72	76	80	82	85	90	92
250	65	73	79	85	90	95	96	100	105	107
275	79	87	94	100	106	110	112	116	121	123
300	95	103	110	117	122	127	129	133	138	141

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½" ICE	**½" ICE**	**6 LB. WIND**	**4 LB. WIND, ½" ICE**
DEAD END SPAN (FEET)				
50	3	5	7	*4000
75	6	10	12	*4000
100	11	15	18	*4000
125	17	22	25	*4000
150	25	30	33	*4000
175	34	39	43	*4000
200	44	50	54	*4000
225	56	62	66	*4000
250	70	76	79	*4000
275	84	90	94	*4000
300	100	106	110	*4000
** Note: Design Specification Constraint*				

****** Simulated with a maximum tension of 4000 lbs. ******

Std. Item:	W21NF
Item ID:	5941794E
CU:	C795ASSTBRNE

PHYSICAL PROPERTIES	
R.B.S.	28,200 lbs.
C.S.A.	0.7049 sq. in.
R. (@ 25˚C)	0.0222 Ω / 1000’
R. (@ 75˚C)	0.0265 Ω / 1000’
CONDUCTOR DIAMETER	1.093”
WEIGHT	1022 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.6966 Lb/Ft
VERTICAL	2.015 Lb/Ft
TOTAL	2.432 Lb/Ft
SWING	28.14˚

CURRENT CARRYING CAPACITIES		
SUMMER (37.7˚C)	CONDUCTOR TEMPERATURE	WINTER (10˚C)
258	122˚F/50˚C	973
902	176˚F/80˚C	1268
1124	212˚F/100˚C	1418
1447	284˚F/140˚C	1662

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	2446	1557	1165	938	2192	1537	1228	1028	2004	1523	1274	1100	1874	1513	1310	1157
ACTUAL SPAN (FEET)																
50	2	2	3	4	2	2	3	4	2	3	3	3	2	3	3	3
60	2	4	5	6	3	4	5	5	3	4	4	5	3	4	4	5
70	3	5	6	8	3	5	6	7	4	5	6	7	4	5	6	7
80	4	6	8	10	4	6	8	10	5	6	8	9	5	6	8	8
90	5	8	11	13	6	8	10	12	6	8	10	11	7	8	10	11
100	6	10	13	16	7	10	13	15	8	10	12	14	8	10	12	13
110	8	12	16	20	8	12	15	18	9	12	15	17	10	12	14	16
120	9	14	19	24	10	14	18	22	11	15	17	20	12	15	17	19
130	11	17	22	28	12	17	21	25	13	17	20	24	14	17	20	22
140	12	19	26	32	14	20	25	29	15	20	24	27	16	20	23	26
150	14	22	30	37	16	22	28	34	17	23	27	31	18	23	26	30
160	16	25	34	42	18	26	32	38	20	26	31	36	21	26	30	34
170	18	29	38	47	20	29	36	43	22	29	35	40	24	29	34	38
180	20	32	43	53	23	32	41	48	25	33	39	45	27	33	38	43
190	23	36	48	59	25	36	45	54	28	36	44	50	30	37	42	48
200	25	39	53	66	28	40	50	60	31	40	48	56	33	41	47	53
210	28	44	58	72	31	44	55	66	34	45	53	62	36	45	52	59
220	30	48	64	79	34	48	61	72	37	49	58	68	40	49	57	64
230	33	52	70	87	37	53	66	79	41	53	64	74	43	54	62	70
240	36	57	76	94	40	58	72	86	44	58	69	81	47	59	68	77
250	39	62	82	103	44	62	78	94	48	63	75	87	51	63	73	83
260	42	67	89	111	47	68	85	101	52	68	82	95	55	69	79	90
270	46	71	96	120	51	73	91	109	56	74	88	102	60	74	59	97
280	49	77	103	129	55	78	98	117	60	79	95	110	64	80	92	104
290	53	83	111	138	59	84	105	126	64	85	101	118	69	85	99	112
300	57	89	119	148	63	90	113	135	69	91	109	126	74	91	106	120

****** Simulated with a maximum tension of 3500 lbs. ******

Item ID:	5941794^E
CU:	C795ASSTBRNE

	FINAL SAG TABLE									
	LOADING (UNLOADED CONDITIONS)									
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**212**	**257**	**284**
TEMP. ˚C	**-20**	**0**	**15**	**32**	**50**	**70**	**80**	**100**	**125**	**140**
DEAD END SPAN (FEET)										
50	1	3	6	8	9	10	11	12	14	15
75	3	6	10	13	15	17	18	20	21	23
100	6	11	16	20	22	24	25	27	30	31
125	11	17	22	27	30	32	34	36	39	41
150	17	24	30	36	38	42	43	46	49	51
175	25	33	39	45	48	52	53	57	60	63
200	35	43	49	55	59	63	65	68	72	75
225	45	54	60	67	71	75	77	81	85	88
250	58	66	73	80	85	89	91	95	99	102
275	71	80	87	94	100	104	106	110	115	117
300	87	95	102	110	115	120	122	126	131	134

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			**TENSION (LBS.)**
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½" ICE	**½" ICE**	**6 LB. WIND**	**4 LB. WIND, ½" ICE**
DEAD END SPAN (FEET)				
50	3	4	6	*3500
75	6	8	11	*3500
100	10	14	16	*3500
125	16	20	23	*3500
150	23	28	30	*3500
175	32	37	39	*3500
200	42	47	50	*3500
225	53	58	61	*3500
250	65	71	74	*3500
275	79	84	87	*3500
300	94	100	102	*3500
** Note: Design Specification Constraint*				

****** Simulated with a maximum tension of 3500 lbs. ******

td. Item:	
Item ID:	5941551
CU:	477BACSR

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	19,500 lbs.	TRANSVERSE	0.6174 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.4353 sq. in.	VERTICAL	1.501 Lb/Ft			
R. (@ 25˚C)	0.0366 Ω / 1000’	TOTAL	1.923 Lb/Ft	658	NORMAL	938
R. (@ 75˚C)	0.0438 Ω / 1000’			742	EMERGENCY	991
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	33.18˚			
CONDUCTOR DIAMETER	0.858” (Nominal)					
WEIGHT	656 lbs / 1000’					

INITIAL SAG TABLE

	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	2200	1333	913	691	1936	1255	937	750	1707	1200	954	796	1533	1161	967	832
ACTUAL SPAN (FEET)																
50	1	2	3	4	1	2	3	3	1	2	3	3	2	2	3	3
60	2	3	4	5	2	3	4	5	2	3	4	4	2	3	4	4
70	2	4	5	7	2	4	5	6	3	4	5	6	3	4	5	6
80	3	5	7	9	3	5	7	8	4	5	7	8	4	5	7	8
90	4	6	9	12	4	6	9	11	5	7	8	10	5	7	8	10
100	4	7	11	14	5	8	11	13	6	8	10	12	6	8	10	12
110	5	9	13	17	6	9	13	16	7	10	12	15	8	10	12	14
120	6	11	16	21	7	11	15	19	8	12	15	18	9	12	15	17
130	8	12	18	24	9	13	18	22	10	14	17	21	11	14	17	20
140	9	14	21	28	10	15	21	26	11	16	20	24	13	17	20	23
150	10	17	24	32	11	18	24	30	13	18	23	28	14	19	23	27
160	11	19	28	36	13	20	27	34	15	21	26	32	16	22	26	30
170	13	21	31	41	15	23	30	38	17	24	30	36	19	25	29	34
180	14	24	35	46	16	25	34	43	19	27	33	40	21	27	33	38
190	16	27	39	51	18	28	38	47	21	30	37	45	23	31	37	43
200	18	30	43	57	20	31	42	53	23	33	41	50	26	34	41	47
210	20	33	48	63	22	35	46	58	25	36	45	55	28	37	45	52
220	22	36	52	69	25	38	51	64	28	40	50	60	31	41	49	57
230	24	39	57	75	27	41	56	69	31	43	55	65	34	45	54	63
240	26	43	62	82	29	45	61	76	33	47	59	71	37	49	59	68
250	28	46	67	89	32	49	66	82	36	51	64	77	40	53	64	74
260	30	50	73	96	34	53	71	89	39	55	70	84	43	57	69	80
270	33	54	79	104	37	57	77	96	42	60	75	90	47	62	74	86
280	35	58	85	112	40	61	82	103	45	64	81	97	50	66	80	93
290	38	62	91	120	43	66	88	111	48	69	87	104	54	71	86	100
300	40	66	97	128	46	71	95	118	52	74	93	111	58	76	92	107

****** Simulated with a maximum tension of 3000 lbs. ******

CU:	477BACSR

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1	2	4	6	8	9	10	11
75	2	4	8	11	13	15	16	17
100	4	8	13	17	19	22	23	24
125	7	13	19	2	26	29	31	32
150	12	20	26	31	34	38	39	41
175	19	27	34	40	43	47	49	51
200	27	36	43	50	53	57	59	61
225	37	47	54	61	64	69	71	73
250	49	58	65	72	77	81	83	85
275	61	71	78	85	90	95	97	99
300	75	84	92	99	104	109	112	114

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	2	3	5	3000*
75	5	7	9	3000*
100	10	12	14	3000*
125	15	18	20	3000*
150	22	25	27	3000*
175	30	33	35	3000*
200	39	42	44	3000*
225	49	53	55	3000*
250	60	64	66	3000*
275	73	77	79	3000*
300	87	91	93	3000*
** Note: Design Specification Constraint*				

****** Simulated with a maximum tension of 3000 lbs. ******

Std. Item:	W21BA
Item ID:	0811125
CU:	C477ALSTBR

PHYSICAL PROPERTIES	
R.B.S.	8,360 lbs.
C.S.A.	0.3744 sq. in.
R. (@ 25˚C)	0.0373 Ω / 1000'
R. (@ 75˚C)	0.0445 Ω / 1000'
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.793"
WEIGHT	446.8 lbs / 1000'

LOADING PROPERTIES	
TRANSVERSE	0.5992 Lb/Ft
VERTICAL	1.252 Lb/Ft
TOTAL	1.688 Lb/Ft
SWING	41.59˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
640	**NORMAL**	908
721	**EMERGENCY**	960

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				**150**				**175**				**200**			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	1086	616	451	363	885	590	470	394	765	574	482	419	695	564	492	438
ACTUAL SPAN (FEET)																
50	2	3	4	5	2	3	4	4	2	3	3	4	2	3	3	4
60	2	4	5	7	3	4	5	6	3	4	5	6	3	4	5	6
70	3	5	7	9	4	6	7	8	4	6	7	8	5	6	7	8
80	4	7	10	12	5	7	9	11	6	7	9	10	6	8	9	10
90	5	9	12	15	6	9	12	14	7	9	11	13	8	10	11	12
100	6	11	15	19	8	11	14	17	9	12	14	16	10	12	14	15
110	7	13	18	22	9	14	17	21	11	14	17	19	12	14	17	19
120	9	16	21	27	11	16	21	25	13	17	20	23	14	17	20	22
130	10	18	25	31	13	19	24	29	15	20	24	27	16	20	23	26
140	12	21	29	36	15	22	28	33	17	23	27	31	19	23	27	30
150	14	25	34	42	17	26	32	38	20	26	31	36	22	27	31	35
160	16	28	38	47	19	29	37	44	22	30	36	41	25	31	35	39
170	18	32	43	54	22	33	41	49	25	34	40	46	28	34	40	44
180	20	35	48	60	25	37	46	55	28	38	45	52	31	39	44	50
190	22	39	54	67	27	41	52	62	32	42	50	58	35	43	49	55
200	25	44	60	74	30	46	57	68	35	47	56	64	39	48	55	61
210	27	48	66	82	33	50	63	75	39	52	61	71	43	53	60	68
220	30	53	72	90	37	55	69	83	43	57	67	78	47	58	66	74
230	33	58	79	98	40	60	76	90	46	62	74	85	51	63	72	81
240	36	63	86	107	44	66	83	98	51	67	80	93	56	69	79	89
250	39	68	93	116	47	71	90	107	55	73	87	100	60	75	86	96
260	42	74	101	126	51	77	97	115	59	79	94	109	65	81	93	104
270	45	80	109	135	55	83	104	124	64	85	102	117	70	87	100	112
280	49	86	117	146	60	89	112	134	69	92	109	126	76	94	107	121
290	52	92	125	156	64	96	121	144	74	98	117	135	81	100	115	129
300	56	98	134	167	68	103	129	154	79	105	126	145	87	107	123	139

Std. Item:	W21BA
CU:	C477ALSTBR

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	1	3	7	10	12	14	15	16
75	3	7	12	15	19	22	24	25
100	6	12	18	23	27	31	33	35
125	11	19	25	31	36	41	43	45
150	19	28	34	40	45	51	54	57
175	30	38	45	51	57	63	66	69
200	42	50	57	64	67	77	80	83
225	55	64	71	78	84	92	95	98
250	71	79	86	94	100	108	111	115
275	87	96	103	111	117	125	129	133
300	106	115	122	129	136	144	148	152

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	3	5	7	*2000
75	7	10	12	*2000
100	13	16	18	*2000
125	20	23	26	*2000
150	29	33	35	*2000
175	39	43	46	*1995
200	51	55	58	*1989
225	65	69	72	*1986
250	80	85	87	*1986
275	97	102	104	*1986
300	115	120	123	*1987
** Note: Design Specification Constraint*				

Std. Item:	W21NB
Item ID:	5942639[E]
CU:	C477ALTWHMP35KNE
CU:	C477ALSCHMP35KNE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	8,360 lbs.	**TRANSVERSE**	0.7866 Lb/Ft	**SUMMER (37.7˚C)**	**MAXIMUM AMPACITY**	**WINTER (10˚C)**
C.S.A.	0.3746 sq. in.	**VERTICAL**	2.061 Lb/Ft			
R. (@ 25˚C)	0.0373 Ω / 1000’	**TOTAL**	2.506 Lb/Ft	435	**NORMAL**	710
R. (@ 75˚C)	0.0447 Ω / 1000’			543	**EMERGENCY**	770
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	**SWING**	37.02˚			
CONDUCTOR DIAMETER	0.722”					
COMPLETE DIAMETER	1.362” (Nominal)					
WEIGHT	903 lbs / 1000’					

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	822	675	593	531	789	687	624	572	770	695	645	602	758	701	660	624
ACTUAL SPAN (FEET)																
50	4	5	6	6	4	5	5	6	4	5	5	6	4	5	5	5
60	6	7	8	9	6	7	8	9	6	7	8	8	6	7	7	8
70	8	10	11	12	8	10	11	12	9	10	10	11	9	9	10	11
80	11	13	15	16	11	13	14	15	11	12	13	14	11	12	13	14
90	13	16	19	21	14	16	18	19	14	16	17	18	14	16	17	18
100	16	20	23	26	17	20	22	24	18	19	21	23	18	19	21	22
110	20	24	28	31	21	24	26	29	21	24	25	27	22	23	25	26
120	24	29	33	37	25	28	31	34	25	28	30	32	26	28	30	31
130	28	34	39	43	29	33	37	40	30	33	36	38	30	33	35	37
140	32	39	45	50	34	39	43	46	35	38	41	44	35	38	40	43
150	37	45	51	57	39	44	49	53	40	44	47	51	40	44	46	49
160	42	51	59	65	44	51	56	61	45	50	54	58	46	50	53	56
170	48	58	66	74	50	57	63	69	51	56	61	65	52	56	59	63
180	53	65	74	83	56	64	70	77	57	63	68	73	58	63	67	70
190	60	73	83	92	62	71	78	86	64	70	76	81	65	70	74	79
200	66	80	92	102	69	79	87	95	70	78	84	90	72	77	82	87
210	73	89	101	113	76	87	96	105	78	86	93	99	79	85	91	96
220	80	97	111	124	83	96	105	115	85	94	102	109	87	94	99	105
230	87	106	121	135	91	104	115	126	93	103	111	119	95	102	109	115
240	95	116	132	147	99	114	125	137	102	112	121	130	103	112	118	125
250	103	126	143	160	108	123	136	149	110	122	132	141	112	121	128	136
260	112	136	155	173	116	134	147	161	119	132	142	153	121	131	139	147
270	120	147	167	187	125	144	159	173	129	142	153	165	131	141	150	159
280	129	158	180	201	135	155	171	186	138	153	165	177	141	152	161	171
290	139	169	193	215	145	166	183	200	148	164	177	190	151	163	173	183
300	149	181	206	231	155	178	196	214	159	176	190	203	161	174	185	196

Std. Item:	W21NB
Item ID:	5942639[E]
CU:	C477ALSCHMP35KNE

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	3	7	9	12	14	16	17	18
75	8	13	16	20	22	25	27	28
100	16	21	25	29	32	36	38	39
125	26	32	36	40	44	49	51	52
150	39	45	50	54	58	63	65	67
175	55	60	65	70	74	79	82	84
200	72	78	83	88	92	98	100	103
225	92	98	103	108	113	118	121	124
250	115	121	125	130	135	141	144	147
275	140	145	150	155	160	166	169	172
300	167	173	177	183	188	194	197	200

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	5	8	9	*2000
75	11	14	17	*2000
100	19	23	26	*2000
125	29	34	37	*2000
150	42	47	50	*2000
175	58	62	65	*2000
200	75	80	83	*2000
225	95	100	103	*2000
250	118	123	13	*2000
275	143	147	151	*2000
300	170	175	178	*2000
** Note: Design Specification Constraint*				

Std. Item:	TC52
Item ID:	4035236[Y]
CU:	C33ASSTBR

PHYSICAL PROPERTIES	
R.B.S.	8,700 lbs.
C.S.A.	0.2789 sq. in.
R. (@ 25˚C)	0.0523 Ω / 1000’
R. (@ 75˚C)	0.0625 Ω / 1000’
CONDUCTOR DIAMETER	0.684”
WEIGHT	365 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.5617 Lb/Ft
VERTICAL	1.101 Lb/Ft
TOTAL	1.536 Lb/Ft
SWING	43.14˚

CURRENT CARRYING CAPACITIES		
SUMMER (37.7˚C)	**CONDUCTOR TEMPERATURE**	**WINTER (10˚C)**
187	122˚F/50˚C	555
519	176˚F/80˚C	719
640	212˚F/100˚C	801
757	257˚F/125˚C	888

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				**150**				**175**				**200**			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	2400	1624	972	552	2449	1690	1063	643	2398	1655	1072	693	2217	1503	1001	696
ACTUAL SPAN (FEET)																
50	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2
60	1	1	2	4	1	1	2	3	1	1	2	3	1	1	2	3
70	1	2	3	5	1	2	3	4	1	2	3	4	1	2	3	4
80	1	2	4	6	1	2	3	5	1	2	3	5	2	2	3	5
90	2	3	5	8	2	3	4	7	2	3	4	6	2	3	4	6
100	2	3	6	10	2	3	5	9	2	3	5	8	2	4	5	8
110	3	4	7	12	3	4	6	10	3	4	6	10	3	4	7	10
120	3	5	8	14	3	5	7	12	3	5	7	11	4	5	8	11
130	4	6	10	17	4	5	9	14	4	6	9	13	4	6	9	13
140	4	7	11	19	4	6	10	17	4	6	10	15	5	7	11	15
150	5	8	13	22	5	7	12	19	5	7	11	18	6	8	12	18
160	6	9	14	25	6	8	13	22	6	8	13	20	6	9	14	20
170	7	10	16	29	6	9	15	25	7	10	15	23	7	11	16	23
180	7	11	18	32	7	10	17	28	7	11	17	26	8	12	18	25
190	8	12	20	36	8	12	19	31	8	12	18	29	9	13	20	28
200	9	13	23	40	9	13	21	34	9	13	20	32	10	15	22	31
210	10	15	25	44	10	14	23	38	10	15	23	35	11	16	24	35
220	11	16	27	48	11	16	25	41	11	16	25	38	12	18	26	38
230	12	18	30	53	12	17	27	45	12	17	27	42	13	19	29	42
240	13	19	32	57	13	19	30	49	13	19	29	46	14	21	32	45
250	14	21	35	62	14	20	32	53	14	21	32	49	15	23	34	49
260	15	23	38	67	15	22	35	58	15	22	35	53	17	25	37	53
270	17	25	41	72	16	24	38	62	17	24	37	58	18	27	40	57
280	18	26	44	78	18	25	40	67	18	26	40	62	19	29	43	62
290	19	28	47	84	19	27	43	72	19	28	43	67	21	31	46	66
300	21	30	51	89	20	29	46	77	21	30	46	71	22	33	49	71

****** Simulated with a maximum tension of 3000 lbs. ******

Std. Item:	TC52
CU:	C33ASSTBR

FINAL SAG TABLE										
	LOADING (UNLOADED CONDITIONS)									
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**212**	**257**	**284**
TEMP. ˚C	**-20**	**0**	**15**	**32**	**50**	**70**	**80**	**100**	**125**	**140**
DEAD END SPAN (FEET)										
50	1	1	3	7	8	10	10	12	13	14
75	1	3	6	11	14	16	17	18	20	21
100	3	5	9	15	20	22	23	25	28	29
125	4	7	13	20	26	29	31	33	36	38
150	6	10	16	24	31	37	38	41	44	46
175	8	14	21	30	38	45	47	50	54	56
200	12	19	28	38	46	55	57	60	64	66
225	17	26	36	46	55	65	68	71	75	78
250	23	35	45	56	65	75	79	83	87	90
275	31	44	55	66	75	86	91	95	100	103
300	41	55	66	77	87	98	103	109	114	117

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	3	3	4	2291
75	5	6	7	2414
100	9	10	10	2553
125	13	15	14	2700
150	18	19	18	2849
175	24	25	24	*2936
200	31	33	31	*2948
225	39	41	39	*2958
250	49	50	48	*2965
275	59	61	58	*2971
300	70	72	69	*2976
** Note: Design Specification Constraint*				

****** Simulated with a maximum tension of 3000 lbs. ******

Std. Item:	W20B
Item ID:	4035204
CU:	C33ALSTBR

PHYSICAL PROPERTIES	
R.B.S.	6,150 lbs.
C.S.A.	0.2644 sq. in.
R. (@ 25˚C)	0.0527 Ω / 1000’
R. (@ 75˚C)	0.0629 Ω / 1000’
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.666”
WEIGHT	315.5 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.5556 Lb/Ft
VERTICAL	1.041 Lb/Ft
TOTAL	1.480 Lb/Ft
SWING	46.55˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
514	NORMAL	725
578	EMERGENCY	766

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	1445	819	484	334	1221	701	469	353	1001	619	459	368	824	567	452	379
ACTUAL SPAN (FEET)																
50	1	1	2	4	1	2	3	3	1	2	3	3	1	2	3	3
60	1	2	4	5	1	2	4	5	2	3	4	5	2	3	4	5
70	2	3	5	7	2	3	5	7	2	4	5	6	3	4	5	6
80	2	4	6	9	2	4	6	9	3	5	7	8	4	5	7	8
90	3	5	8	11	3	5	8	11	4	6	8	10	5	7	9	10
100	3	6	10	14	4	7	10	13	5	8	10	13	6	8	10	13
110	4	7	12	17	5	8	12	16	6	9	13	16	7	10	13	15
120	5	8	14	20	6	10	15	19	7	11	15	19	8	12	15	18
130	6	10	17	24	7	11	17	23	8	13	17	22	10	14	18	21
140	6	11	19	28	8	13	20	26	9	15	20	25	11	16	21	25
150	7	13	22	32	9	15	23	30	11	17	23	29	13	19	24	28
160	8	15	25	36	10	17	26	34	12	20	26	33	15	21	27	32
170	9	17	28	41	11	20	29	39	14	22	30	37	17	24	30	36
180	11	19	32	46	13	22	33	43	15	25	34	42	19	27	34	41
190	12	21	35	51	14	24	37	48	17	28	37	47	21	30	38	45
200	13	23	39	57	16	27	40	54	19	31	41	52	23	33	42	50
210	14	26	43	63	17	30	45	59	21	34	46	57	25	37	46	55
220	16	28	47	69	19	33	49	65	23	37	50	62	28	40	51	61
230	17	31	52	75	21	36	54	71	25	41	55	68	30	44	56	66
240	19	33	56	82	22	39	58	77	27	44	60	74	33	48	60	72
250	21	36	61	89	24	42	63	84	30	48	65	81	36	52	66	78
260	22	39	66	96	26	46	68	91	32	52	70	87	39	57	71	85
270	24	42	71	104	28	49	74	98	35	56	75	94	42	61	77	91
280	26	45	77	111	30	53	79	105	37	60	81	101	45	66	82	98
290	28	49	82	120	33	57	85	113	40	64	87	109	48	70	88	105
300	30	52	88	128	35	61	91	121	43	69	93	116	52	75	95	113

336.4 KCMIL, 19 STRAND, BARE AAC, “TULIP”

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1	2	5	9	11	14	15	16
75	2	4	9	13	17	21	22	24
100	3	7	13	19	23	28	30	32
125	6	12	19	26	31	37	40	42
150	11	19	27	34	40	47	49	52
175	18	28	36	44	50	57	60	63
200	28	39	47	55	61	69	73	76
225	40	50	59	67	74	82	86	89
250	53	64	72	80	88	96	100	104
275	68	78	87	95	103	112	116	120
300	84	94	103	111	119	128	133	137

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	3	4	6	1710
75	7	8	9	1862
100	11	13	14	*2000
125	17	19	21	*2000
150	25	27	28	*2000
175	34	37	38	*1996
200	45	47	48	*1993
225	56	60	60	*1992
250	70	73	74	*1992
275	84	88	88	*1992
300	100	104	105	*1992
** Note: Design Specification Constraint*				

Std. Item:	W14B
Item ID:	0811017
CU:	C10AAACBR

PHYSICAL PROPERTIES	
R.B.S.	4,415 lbs.
C.S.A.	0.0968 sq. in.
R. (@ 25˚C)	0.166 Ω / 1000’
R. (@ 75˚C)	0.195 Ω / 1000’
TEMP. LIMIT	176˚F (80˚C) / 194˚F (90˚C)
CONDUCTOR DIAMETER	0.398”
WEIGHT	115 lbs / 1000’

LOADING PROPERTIES	
TRANSVERSE	0.4656 Lb/Ft
VERTICAL	0.675 Lb/Ft
TOTAL	1.120 Lb/Ft
SWING	59.98˚

ELECTRICAL PROPERTIES		
SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
256	NORMAL	354
286	EMERGENCY	374

INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	1229	940	698	459	1236	949	708	474	1243	957	718	489	1251	966	729	504
ACTUAL SPAN (FEET)																
50	0	0	0	1	0	0	1	1	0	0	1	1	0	0	1	1
60	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
70	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	2
80	1	1	1	2	1	1	2	2	1	1	2	2	1	1	2	2
90	1	1	1	2	1	1	2	3	1	1	2	3	1	1	2	3
100	1	2	2	2	1	2	2	4	1	2	2	4	1	2	2	3
110	2	2	2	3	2	2	3	4	2	2	3	4	2	2	3	4
120	2	3	3	4	2	3	4	5	2	3	3	5	2	3	3	5
130	2	3	3	4	2	3	4	6	2	3	4	6	2	3	4	6
140	3	4	4	5	3	4	5	7	3	4	5	7	3	4	5	7
150	3	4	4	6	3	4	6	8	3	4	5	8	3	4	5	8
160	4	5	5	6	4	5	6	9	4	5	6	9	4	5	6	9
170	4	5	5	7	4	5	7	11	4	5	7	10	4	5	7	10
180	5	6	6	8	5	6	8	12	5	6	8	12	5	6	8	11
190	5	7	7	9	5	7	9	13	5	7	9	13	5	7	9	12
200	6	7	7	10	6	7	10	15	6	7	10	14	6	7	10	14
210	6	8	8	11	6	8	11	16	6	8	11	16	6	8	11	15
220	7	9	9	12	7	9	12	18	7	9	12	17	7	9	12	17
230	7	10	10	13	7	10	13	19	7	10	13	19	7	10	13	18
240	8	11	10	14	8	11	14	21	8	10	14	21	8	10	14	20
250	9	12	11	16	9	11	15	23	9	11	15	22	9	11	15	22
260	10	13	12	17	10	12	17	25	9	12	16	24	9	12	16	23
270	10	13	13	18	10	13	18	27	10	13	18	26	10	13	17	25
280	11	15	14	20	11	14	19	29	11	14	19	28	11	14	19	27
290	12	16	15	21	12	15	21	31	12	15	20	30	12	15	20	29
300	13	17	16	22	13	17	22	33	13	16	22	32	13	16	21	31

Item ID:	0811017
CU:	C10AAACBR

FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	0	32	60	90	120	158	176	194
TEMP. ˚C	-18	0	15	32	50	70	80	90
	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded	Unloaded
DEAD END SPAN (FEET)								
50	1	1	1	3	7	10	12	13
75	1	1	2	5	11	16	18	20
100	2	2	4	8	15	21	24	27
125	2	4	6	12	19	27	30	33
150	3	5	8	15	24	33	37	40
175	5	7	11	19	29	39	44	48
200	6	9	14	23	34	45	50	55
225	8	11	17	27	39	52	57	62
250	10	14	21	32	44	58	64	69
275	12	17	24	37	50	65	71	77
300	15	23	33	46	60	75	82	88

FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			TENSION (LBS.)
TEMP. ˚F	0	32	60	0
TEMP. ˚C	-18	0	15	-18
	4 LB. WIND, ½” ICE	½” ICE	6 LB. WIND	4 LB. WIND, ½” ICE
DEAD END SPAN (FEET)				
50	4	3	2	1195
75	7	6	4	1273
100	12	11	7	1360
125	18	16	10	1451
150	24	21	14	1542
175	32	27	18	1632
200	39	34	22	1721
225	47	41	27	1808
250	55	48	32	1893
275	64	55	37	1976
300	76	66	46	*2000
** Note: Design Specification Constraint*				

Std. Item:	W21NA
Item ID:	5942107[E]
CU:	C1/0ALHMPESTNE
CU:	C10ALSCHMPNE

PHYSICAL PROPERTIES		LOADING PROPERTIES		ELECTRICAL PROPERTIES		
R.B.S.	4,270 lbs.	TRANSVERSE	0.6776 Lb/Ft	SUMMER (37.7˚C)	MAXIMUM AMPACITY	WINTER (10˚C)
C.S.A.	0.0968 sq. in.	VERTICAL	1.374 Lb/Ft			
R. (@ 25˚C)	0.166 Ω / 1000’	TOTAL	1.832 Lb/Ft	196	NORMAL	316
R. (@ 75˚C)	0.195 Ω / 1000’			243	EMERGENCY	343
TEMP. LIMIT	167˚F (75˚C) / 194˚F (90˚C)	SWING	50.48˚			
CONDUCTOR DIAMETER	0.398”					
COMPLETE DIAMETER	1.028” (Nominal)					
WEIGHT	424 lbs / 1000’					

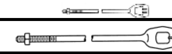
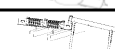
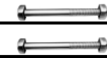
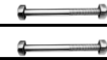
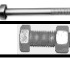
INITIAL SAG TABLE																
	RULING SPAN (FEET)															
	125				150				175				200			
TEMP. ˚F	0	32	60	90	0	32	60	90	0	32	60	90	0	32	60	90
TEMP. ˚C	-18	0	15	32	-18	0	15	32	-18	0	15	32	-18	0	15	32
TENSION (LBS.)	939	556	416	338	755	527	428	364	654	510	436	383	597	499	441	397
ACTUAL SPAN (FEET)																
50	2	3	4	5	2	3	4	4	2	3	4	4	3	3	4	4
60	2	4	6	7	3	4	5	6	4	4	5	6	4	5	5	6
70	3	6	7	9	4	6	7	9	5	6	7	8	5	6	7	8
80	4	7	10	12	5	8	10	11	6	8	9	11	7	8	9	10
90	5	9	12	15	7	10	12	14	8	10	12	13	9	10	12	13
100	7	11	15	19	8	12	15	18	10	12	15	17	11	13	14	16
110	8	14	18	23	10	15	18	21	12	15	18	20	13	15	17	19
120	10	16	22	27	12	17	21	25	14	18	21	24	15	18	21	23
130	11	19	26	32	14	20	25	30	16	21	25	28	18	22	24	27
140	13	22	30	37	17	24	29	34	19	24	29	33	21	25	28	31
150	15	26	34	42	19	27	33	39	22	28	33	37	24	29	32	36
160	17	29	39	48	22	31	38	45	25	32	37	43	27	33	37	41
170	20	33	44	54	24	35	43	51	28	36	42	48	31	37	42	46
180	22	37	50	61	27	39	48	57	32	40	47	54	35	41	47	52
190	24	41	55	68	30	44	54	63	35	45	53	60	38	46	52	58
200	27	46	61	75	34	48	60	70	39	50	58	67	43	51	58	64
210	30	51	67	83	37	53	66	77	43	55	64	73	47	56	64	71
220	33	55	74	91	41	58	72	85	47	60	71	81	52	62	70	78
230	36	61	81	100	45	64	79	93	51	66	77	88	56	68	76	85
240	39	66	88	109	49	70	86	101	56	72	84	96	61	74	83	92
250	42	72	96	118	53	75	93	110	61	78	91	104	67	80	90	100
260	46	77	103	127	57	82	101	119	66	84	99	113	72	86	98	108
270	49	84	112	137	61	88	109	128	71	91	107	121	78	93	105	117
280	53	90	120	148	66	95	117	137	76	98	115	131	84	100	113	126
290	57	96	129	159	71	102	125	147	82	105	123	140	90	107	121	135
300	61	103	138	170	76	109	134	158	88	112	132	150	96	115	130	145

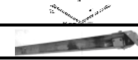
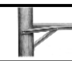
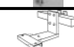
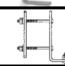
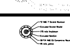
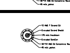
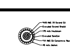
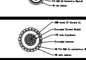
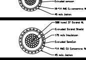
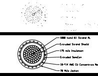
Item ID:	5942107[E]
CU:	C1/0ALHMPESTNE
CU:	C10ALSCHMPNE

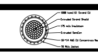
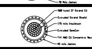
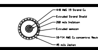
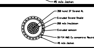
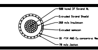
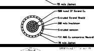
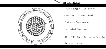
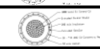
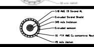
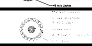
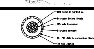
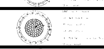
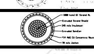
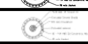
FINAL SAG TABLE								
	LOADING (UNLOADED CONDITIONS)							
TEMP. ˚F	**0**	**32**	**60**	**90**	**120**	**158**	**176**	**194**
TEMP. ˚C	**-18**	**0**	**15**	**32**	**50**	**70**	**80**	**90**
	Unloaded	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**	**Unloaded**
DEAD END SPAN (FEET)								
50	1	5	9	11	13	15	16	17
75	3	9	13	17	20	24	25	26
100	6	14	19	24	28	32	34	36
125	13	21	27	32	37	42	44	46
150	23	31	37	43	48	53	56	58
175	34	42	48	54	60	66	69	72
200	47	55	61	68	73	80	83	86
225	61	70	76	83	89	96	99	102
250	78	86	93	99	105	113	116	120
275	96	104	111	117	124	132	135	138
300	116	124	131	137	144	152	156	159

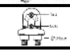
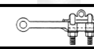
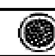
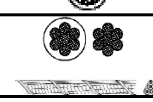
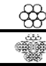
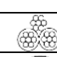
FINAL SAG TABLE				
	LOADING (LOADED CONDITIONS)			**TENSION (LBS.)**
TEMP. ˚F	**0**	**32**	**60**	**0**
TEMP. ˚C	**-18**	**0**	**15**	**-18**
	4 LB. WIND, ½” ICE	**½” ICE**	**6 LB. WIND**	**4 LB. WIND, ½” ICE**
DEAD END SPAN (FEET)				
50	4	7	9	1549
75	9	11	14	1817
100	14	17	20	*2000
125	21	25	28	*2000
150	31	35	38	*2000
175	42	47	49	*2000
200	55	60	62	*2000
225	70	74	77	*2000
250	86	91	94	*2000
275	104	109	112	*2000
300	124	129	132	*2000
** Note: Design Specification Constraint*				

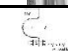
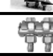
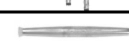
Version	Date	Modification	Author(s)	Approval by (Name/Title)
8	7/21	• Revised drawings 21-218, 21-222, and 21-230.		
7	7/20	• Revised drawings 21-45 thru 21-47, 21-108, 21-113, 21-218, 21-221 thru 21-223, 21-246, and 21-303		
6	7/19	• Revised drawings 21-300 thru 21-303 • Added shield wire drawings 21-304, 21-305 • Updated 21.8.10 and removed 21.8.30		
5	7/18	• Added shieldwire drawings 21-300 thru 21-303 • Revised insulator plate for drawing 21-236.		
4	7/17	• Added section 21.7 Structure Type Selection. • Added section 21.8 Insulators. • Added section 21.9 Risk Mitigation at Line Crossings. • Added section 21.10 Structure Labeling. • Removed references to 69kV where applicable (various sections and tables). • Revised drawings 21-101 thru 103, 105, 107, 108, 113, 211, 213, 217 thru 224, 226, 228, 230, 231, 236, 241 thru 247.		
3	7/16	• Revised all drawings to 3D • Added drawing 21-219 • Added Drawing 21-300		
2	7/15	• Removed Drawing 21-109 and 21-229. Added drawings 21-213, 21-221, 21-231, 21-241, 21-242, 21-243, 21-244, 21-245, 21-246 and 21-247. • All drawings redrawn for clarity and table information added. • 69kV removed from this standard. To be designed according to Transmission Engineering standards.		
1	07/12	• Added Flat & Vertical Configuration Structure Drawings (pages 21-200 through 21-236). • Added Clearance Information (Section 21.6). • Added Conductor Information (Section 21.5 & pages 21-400 through 21-418).		

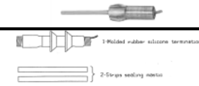
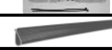
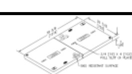
MATERIAL	STD ITEM	ILLUSTRATION
• **Adapter**		
○ Male, Schedule 40 PVC Conduit	UK7M0 – UK7M3	
○ PVC, Female	UK6F0 – UK6F6	
• **Anchors**		
○ Bust Expansion	A9	
○ Expanding Rock	A13A5 – A13A8	
○ Plank	A17A – A17C	
○ Power Installed Screw (PISA)	A16A – A16C	
○ Rock, Pole Leg (One)	P14A	
○ Rod Coupling (PISA)	A20C	
○ Rod Eye – Auxiliary	A24	
○ Rod (PISA)	A18H – A18K	
○ Rod	A18N1 - A18N3	
○ Steelwing Screw	A9	
○ Thimble Eyenuts	A22J	
• **Animal Guards**		
○ Bushings	T22A – T22F1	
○ Conductor	T43	
○ Electrostatic (formerly Guthrie Guard)	T21	
○ Polymer Cutouts	T45	
○ Stinger Wire	T23A – T23C	
○ Line Post Sensor	T22M	
○ Wildlife Protector	T40 – T43	
• **Arrester**		
○ Isolating Gap	L2	
○ Line Type, 5-25kV	L3A - L3J	
○ Line Type, 35kV	L3K - L3M	
○ Riser Type	L3DR - L3JR	
○ SubT Intermediate Class (NY only)	TL3K-TL3N	
• **Bag, Vinyl (to hold Standards book)**	A80B	
• **Bend/Sweep**	UK7B0 – UK7B7	
• **Bolt**		
○ Captive Bolt Assembly	C35B	
○ Carriage	B8A1 – B8A3	
○ Double Arming – galvanized ⅝”	B15A – B15H	
○ Double Arming – galvanized ¾”	B16A – B16E	
○ Machine – galvanized ⅝” square head	B13A – B13K	
○ Machine – galvanized ¾” square head	B14A – B14H	
○ Machine – galvanized $^{7}/_{8}$” square head	B18A – B18G	
○ Machine – galvanized ⅜” & ½” square head	B1 – B4E5	
○ Machine – galvanized ½” & ⅝” hexagon head	B5C10 – B5W7B	
○ Machine – Stainless Steel	B8B15 - B8C30	
○ Spare U Bolt, for Spacer Cable E-Bracket	A50G	
• **Box**		
○ Cabinet – Junction Box	NS6	
○ Primary Pull & Splice, Rectangular	UR6	

MATERIAL	STD ITEM	ILLUSTRATION
○ Receptacle Box, PVC	UK8B	
• **Brace**		
○ Alley Arm	B36-B36B	
○ Flat Wood Crossarm – One Pair	B37B	
○ Wood Crossarm – Pair	TB60	
○ Wood Crossarm – Distribution Supply Installs	TB60C	
• **Bracket**		
○ Aerial Cable Extension Arm	A51B	
○ Angle Swinging, Distribution Supply	P15	
○ Anti-Sway Brackets 14” & 24”, Spacer Cable	A54B – A54B3	
○ Arrester	C32 – C32G	
○ Arrester Intermediate Class Cross arm mount	TL11	
○ C – 15kV Spacer Cable	P17B	
○ C – 35kV Spacer Cable	P17C	
○ Cutout / Arrester	C33 – C33A	
○ Cutout / Arrester	C35 – C35A	
○ Disconnect – 600A	C38B	
○ Disconnect Mounting	C38A	
○ E – 15kV Spacer Cable	P17A	
○ Equipment Mount - 3Ø	E12M	
○ Equipment Mount - 1Ø	E13M - E13N	
○ Equipment - For DA repeater radio & Omni antenna mounting	E15B	
○ Insulated Service	B53A – B53B	
○ Insulated Service	B54 – B54T	
○ Meter Socket	C39E	
○ Recloser Ladder Bracket	R55	
○ Tangent – Spacer Cable	A50E1 – A50E2	
○ Fiber Optic ADSS	A50F	
• **Braid, Shielding – Copper**	T1T5	
• **Cable**		
○ 15 kV, Aluminum, URD Primary	UC11BC	
○ 15 kV, Aluminum	UC11BJ	
○ 15 kV, Copper	UC11BK – UC11BL	
○ 15 kV, Copper	UC11E	
○ 15 kV, Copper	UC12F	
○ 15 kV, Aluminum	UC12GG	
○ 15 kV, Aluminum	UC12HG	
○ 15 kV, Aluminum	UC12TA – UC12TB	

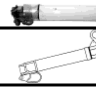
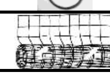
MATERIAL	STD ITEM	ILLUSTRATION
○ 15 kV, Copper	UC12TC – UC12TD	
○ 15 kV, Copper	UC17	
○ 25 kV, Copper	UC23CJ	
○ 25 kV, Copper	UC23EC	
○ 25 kV, Aluminum	UC23FA	
○ 25 kV, Copper	UC23FJ	
○ 25 kV, Aluminum	UC23GA	
○ 25 kV, Copper	UC23GJ	
○ 25 kV, Aluminum	UC23TA	
○ 25 kV, Copper	UC23TC	
○ 35 kV, Aluminum	UC35C1 – UC35C3	
○ 35 kV, Copper	UC35DJ	
○ 35 kV, Copper	UC35GJ	
○ 35 kV, Copper	UC35HJ	
○ 35 kV, Copper	UC35TC – UC35TD	
○ 35 kV, Aluminum	UC35TJ	
○ 46 kV, Copper	UC46	
• **Cable Positioner**	UR47CP	
• **Cable Ties**	UP21T	
• **Capacitor**		
○ Advance Control	C39A1	
○ Bracket, Meter Socket	C39E	
○ Control Cable	C39C – C39D2	
○ Voltage / Current Sensor Post Type	C39CS	
○ Hanger	C36A – C36D	
○ Units	C40AA – C40NB	
○ Line Post Current Sensor	C39CS1 – C39CS3	
○ Pre-assembled Three Phase Fixed Banks	C40PFA-C40PFW	
○ Pre-assembled Three Phase Switched Banks	C40PSA-C40PSZA	
○ Pre-assembled Three Phase Advanced Switched Banks	C40SGC-C40TGZ	
○ Meter Socket	C39F - C39G	
○ Three Phase	C40P	
○ Time Control	C39A	
• **Cement**		
○ PVC	UK6S	
• **Clamp**		
○ Aerial Cable Messenger Support	A50D	
○ Automatic Copper Deadends	D9A – D9A9	
○ Crosby Type of Rope Clip	C25B - C25D	

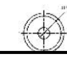
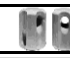
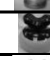
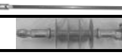
MATERIAL	STD ITEM	ILLUSTRATION
○ Guy – Bolted	G7A – G7B	
○ Guy – U Bolt	G5B	
○ Lashing	NC8E	
○ Messenger / Shieldwire	A50BA	
○ Messenger Permanent Stringing Angle	A50BB	
○ Post Insulating Clamps	I14A – I14H, TC80A – TC80B	
○ Secondary / Neutral Mid-span	C13S	
○ Secondary / Neutral Support	A50B	
○ Single Tongue	NC13A – NC13C	
○ Spring Clamp	US1A – US1B	
○ Strain	C13A1 – C13Q	
○ Suspension	C14A – C14C	
○ Suspension, Double Unit	I15A – I15E	
○ Suspension, Single Unit	I16A – I16B	
○ Suspension – Angle	C15A – C15C	
• **Cleaner, Cable**	UC80F	
• **Clevis**		
○ H/L – Clevis Ball	I18	
○ Insulator Bracket– 600V	I12	
○ Insulated, Spool Type	I11A	
○ Thimble	C5D	
○ Thimble (for use with preformed deadends)	C20	
○ Y-Ball	I17	
• **Clip**		
○ For Connector Taps	C70	
○ Galvanized Conduit	UK3B – UK3F	
• **Compound, Sealing – Plastic Putty**	S3	
○ **Conductors**		
○ 5kV, 1/C, Non-Shielded Medium Voltage, Copper	W33A - W33C	
○ Miscellaneous Wire	W9E – W13L	
○ Pole Top Tap Conductor	W17B – W19G	
○ Pre-Assembled Lashed Aerial Cable	A60E - A62G	
○ Primary Bare Conductor – 35kV Distribution Supply	W21NG - W21NI	
○ Quadriplex Secondary & Service Cable	W16C – W16E	
○ Three Phase Transformer Connections	UC5G	
○ Triplex Secondary & Service Cable	W15B – W15J	
○ Primary Tree Conductor – 15kV	W20CA – W21BG	
○ Primary Tree Conductor – 35kV	W21NA – W21ND	
○ Spacer Cable Messenger	W21NE – W21NF	
○ Tie Wire	W22A – W22D	

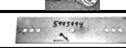
MATERIAL	STD ITEM	ILLUSTRATION
○ Wire Brush	NTE1	
• **Conduit and Fittings**		
○ 1” Non-Metallic Flex	C29B – C29C	
○ 1” PVC	C29E10 – C29H	
○ ¾” PVC	UK7A0 – UK7T0	
○ Conduit Standoff Bracket (for Risers)	UK60 – UK60A	
○ Conduit Standoff Bracket Strap Kit	UK61A - UK61E	
○ Galvanized Sidewalk Strut	G36	
○ Galvanized Steel	UK30A – UK30H	
○ PVC, Schedule 40	UK7A0 – UK7A6	
○ PVC, Type DB	UK6A2 – UK6A6	
○ Strap – Iron	UK45A1 – UK45A3	
○ Weatherhead – ¾” PVC Service Entrance	UK8W	
• **Connectors**		
○ Fired-On-Wedge Covers	S15W – S15Z	
○ Fired-On-Wedge Tap Cartridges	S15CB - S15CY	
○ Fired-On Wedge Taps - Aluminum	S15G – S15X	
○ Fired-On Wedge Taps – Copper	S17R – S17T	
○ Automatic Service Deadend	P55A1 – P55B	
○ Bronze Terminal Lug	C8N1 – C8N3	
○ Compression C-Type Tap	S14A – S14L	
○ Crosby Type or Rope Clip	C25B – C25D	
○ Ground	C23A - C23B	
○ Hot Line, Vice Type	C16C – C16G	
○ Hot Line, Aluminum Clamp Type	C24A – C24CC	
○ Hot Line, Bronze Clamp Type	C24D	
○ Parallel Groove	C7A – C7J	
○ Parallel Groove – Copper	C7K – C7L	
○ Pressure Eyebolt (Cable to Flat)	C17B – C17F	
○ Secondary Terminal Adapter	C8A – C8F	
○ Service	C26	
○ Splice – Automatic, Al & ACSR	S19J – S19T	
○ Splice – Automatic, Steel & Alumoweld	S19P – S19R	
○ Splice – Automatic, Messenger	S19U – S19V	
○ Primary Bare Conductor – 15kV-35kV	TC52, W20A – W21BF	
○ Splice – Automatic, Copper	S19A – S19I	

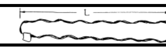
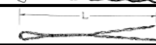
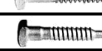
MATERIAL	STD ITEM	ILLUSTRATION
○ Splice - Cold Shrink	UR49A2 – UR49D3	
○ Splice – Compression – ACSR, AAAC	S20B – S20G	
○ Splice – Compression – ACSR – 2 Pc.	S20R1 – S20R4	
○ Splice – Compression – Al	S21C1 – S21M	
○ Weatherproof Secondary (Piercing)	S5 – S6	
○ Splice – Compression – Part. Ten. – Al & ACSR	S22H – S22E	
○ Splice – Compression – Cu & CCW	S23A – S23N, UC60E	
○ Splice – Compression – Loop – Cu	S24E – S24G	
○ Splice – Compression – Loop – Al	S26C – S26D	
○ Splice – Copper Automatic Reducing	S28A – S28J	
○ Splice – Aluminum Automatic Reducing	S28K - S28K1	
○ Splice – Aluminum Compression Reducing	S28L – S28N	
○ Splice – Jumper Loop, Non-Tension	S26E – S26M	
○ Split bolt or two bolt type	C27A – C27H	
○ Standard Compression Tap	S13B – S13N6	
○ Terminal	C9FE – C9FF	
○ Terminal "Flag" Connector / Stirrup	S30B	
○ Terminal Lug – Grounding	C10	
○ Terminal Lug	C9A – C9P	
○ Terminal Plug	S27A – S27L	
○ Termination Cold Shrink	UR43 - UR45C3	
○ Tinned Aluminum Terminal Lug	C9F – C9FD	
○ U Bolt	C7M – C7R	
○ Vise	C6N1 – C6N8	
• **Coupling**		
○ Galvanized Conduit	UK32B – UK32H	
○ PVC	UK6C0 – UK6C6	
• **Covers**		
○ Cover -- Cold Shrink	UR49D1 - UR49D3	
○ Cover – Fired-On Wedge	S15W - S15Z	
○ Cover – Gel Filled Enclosure	C61A – C61B	
○ Cover – Gelwrap For Tree Wire & Spacer Cable	C62-C68	
○ Cover – Messenger	A55	
○ Cover – Snap On For Compression & Bolted	C60B – C60S	
○ Cover – Spacer Cable	S16	
○ Cover – Secondary Service Neutral	S16N	
○ Two Piece, For Primary Pull & Splice, Rectangular	UR6C	

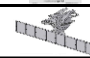
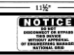
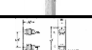
MATERIAL	STD ITEM	ILLUSTRATION
• **Crossarm**		
○ Assembly - for Equipment Platforms	TC20	
○ Fiberglass - Deadend Arm, 8’	C76D	
○ Fiberglass - Tangent Arm, 8’	C76T	
○ Fiberglass - Deadend Arm, 10’	C77D	
○ Fiberglass - Tangent Arm, 10’	C77T	
○ Gain	C37 – C37A	
○ Grid Plate	TC22	
○ 6 Pin Standard Duty – 8’	C31B	
○ 8 Pin Heavy Duty – 10'	C31C	
○ 6 Pin Heavy Duty – 10’	C31D	
○ 2 Pin High Tension – 4’ 10”	C31E	
○ 2 Pin High Tension – 10’	C31F	
○ High tension – 14’, Undrilled	C31G	
○ Transformer / Regular Bank – 18’, Undrilled	C31H	
○ 4 Pin High Tension – 10’	TC10	
• **Cutout**		
○ Enclosed Porcelain 5kV Fused & Disconnecting	C41B1 – C41D2	
○ Open Type – 15kV Standard	C43S10 – C43S31	
○ Open Type – 27kV Standard	C43S41 – C43S51	
○ Power Fuse – (Mounting) SMD – 20	C47A – C48	
• **Electrical Joint Compound**	NG9C – NG9D	
• **End Cap, Cable, Cold Shrink**	UC90C – UC90J	
• **Eyelets**		
○ Eyenut	B22B – B22C	
○ Screw Thimble	B33A	
○ Shoulder – Oval	B32A – B32B	
○ Thimble Eyelet (use with preformed deadends)	B20A – B20B	
○ Thimble Eyelet (use with clevis & pin DE hardware)	B21B – B21C	
• **Eye Socket**	I19A – I19C	
• **Fault Circuit Indicator – LED – 5-46kV**	F3BI – F4T24D	
○ Manual Reset Magnetic Tool	F2T	
• **Fault Circuit Indicator – Collector Box**	F4CB	

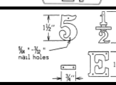
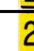
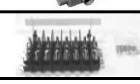
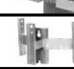
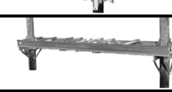
MATERIAL	STD ITEM	ILLUSTRATION
• **Foam**		
○ Expanding	UF10 – UF10A	
○ Fireproof	UF20	
• **Fuse**		
○ Partial Range Current Limiting Fuse	F7A25 – F7C40	
○ Current Limiting Fuse Terminal Adapter	F7B	
○ Current Limiting Fuse	F10A15	
○ Fuse Holder	F50BA	
○ Links – 15kV Type “K”	F1K03 – F1K200	
○ Links – 35kV Type “K”	F1K03A – F1K100A	
○ Links – 15kV Type “T”	F1T03 – F1T200	
○ Power – SM5	F5E100 – F5E400	
○ Power – SMU20 – 14.4kV	F6E020 – F6K200	
○ Power – SMU20 – 25kV	F8E100 - F8K140	
○ Power – SMU20 – 34.5kV	F9K3 - F9K65	
○ Power – (Holder) SMD5	C50B	
○ Sub Transmission Fusing SM5 & SMD1A	TF2A-TF4E	
• **Grease, Inhibiting**	G9B	
• **Grounding**		
○ Accessories Kit for Fiberglass Poles	S34	
○ Clip – Bonding	NC22 – NC23	
○ Flexible Line Arrester	L6 - L6L	
○ Flexible XFMR Arrester Lead	L6B	
○ Ground Grid	TG21	
○ Ground Rod Clamp	G4	
○ Ground Rod Clamp – ⅝”	G2A2 – G2A4	
○ Ground Connector – Vise Type	C23A – C23B	
○ Ground Connector – Cable to Flat	TC27	
○ Ground Rod, Copper Bonded/Copper-Clad	TG20	
○ Ground Wire, Armored Ground Wire Kit	S35	

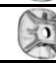
MATERIAL	STD ITEM	ILLUSTRATION
○ Molding – Polyethylene	S1	
○ Termination Grounding Kit	UR47T4	
○ Transformer Neutral/Arrester Ground Strap	S40 – S40B	
• **Guy**		
○ Eye Plate	TG1L0 – TG17	
○ Grip Automatic	G5C2 – G5C6L	
○ Hooks	G33A – G33D	
○ Roller	G50	
○ Sidewalk Strut Fittings	G35A – G35C, UK30D	
○ Thimble	G19	
○ Wire	G15A – G17B	
○ Wire Marker – Yellow (Guy Guard)	G21E	
• **Hangar, Metering**	M36C – M36C1	
• **Insulator**		
○ Guy	I21 – I23	
○ Guy Strain	I24, TI95B – TI95D	
○ Line Post	I13A – I13L	
○ Pin – ANSI standard C29.5	I6A – I6C	
○ Pin – HDPE	I6P – I6PA	
○ Spool – Secondary Rack, 600V	I25	
○ Strain	I2	
○ Strain – Polymer	I7PA – I7PB	
• **Isolator**		
○ Cable – Isolator Ground Marker	P22W	
○ Neutral Isolator – Special	L4A – L4B	
• **Labels** (see also **Signs** or **Tags**)		
○ PCB – Blue With White Lettering	Z11A – Z11B	
○ PCB Information	Z8 – Z10	
○ PCB Warning	Z5 – Z7	
○ 2 $^{7}/_{8}$” Reflective Vinyl Number or Letter	P21L – P21N	
○ Mounting Panels	P21M – P21R15	
○ Transformer Vent	P22T	
○ Warning, Recloser with DITT	P25PR	
• **Limiter, Current Limiting, Cable-To-Mole**	UL3B – UL3E	
• **Link**		
○ Figure 8	C4A	
○ Transmission Chain	C4B	
• **Link Extension Bar**	NL2	

MATERIAL	STD ITEM	ILLUSTRATION
• **Lug**		
○ Terminal, Aluminum	UL16A – UL16R4	
○ Terminal, Copper	UL15A – Ul15R4	
• **Marker, Aerial Line**	L20B - L20F	
• **Nut**		
○ Locknut	L10A – L10E	
○ Square	B17A - B17B	
○ Stainless Steel	B8B40 – B8C40	
• **Paint, Black**	P32	
• **Perforated Strap**	C30	
• **Pin**		
○ Angle	P8 - P8A	
○ Pole Top Bracket	P12B - P12C	
○ Insulator	P1A – P1C2, P3	
○ Pin – 24" Epoxy Standoff	P10B	
○ Pole Top – Epoxy	P6B	
○ Pole Top – Steel	P7A	
○ Stud – Double Ended	P1D – P1G	
• **Plate**		
○ Bar Extension	NL3	
○ Crossarm Reinforcing & Pin Hole Adapter	P2S	
○ Double Insulator	I20B	
○ Guy Eye	TG13 – TG17	
○ Insulator Mounting	I20C	
○ Mounting Arm	I20A	
• **Plug**		
○ Conduit	UK34J – UK34M	
○ Galvanized	UK34D – UK34H	
• **Poles**		
○ Foam Backfill	P85A - P85B	
○ Pole Hub Guard	P26G	
○ Pole Mount – Anchor Leg	P14A – P14CT	
○ Pole Top Extension	P12A – P12A1	
○ Pole Top Protector (Cap)	P9	
○ Poles - Fiberglass	P77A4 - P77H6	
○ Push Brace Attachment	P16	
○ Pole Step - Removable	P78	
○ Wood Poles	P11A1 – P11J3	
○ Steel Guy Stub Pole	P13	

MATERIAL	STD ITEM	ILLUSTRATION
○ Woodpecker Hole Repair	P80 – P80D	
• **Preformed**		
○ Deadends	P52A1 – P52P	
○ Guy Grips of Messenger Deadends	P54A – P54J	
○ Line Guards	P51C – P51V	
○ Tie Wire	TT1B	
• **Primary Metering**		
○ Secondary Conduit Kit	M37	
○ Secondary Mis. Fittings	UK9 – UK10A	
• **Recloser**		
○ Control	R51A – R51B3	
○ Three Phase Recloser With Control & Cabinet	R50A – R50HA	
○ Three Phase (800 A)	R50S15B – R50S38B	
○ Three Phase (800A)	R50SE15B – R50SE38A	
○ Single Phase Recloser With Control & Cabinet	R50SP	
○ Cutout mounted Single Phase Recloser	R53A – R53H	
○ Cellular Radio Modem and antenna kit	R51C-R51C5	
○ Accessories	R52A – R52K1	
• **Reflector – 3” X 10” Aluminum**	Z12A – Z12D	
• **Regulator**		
○ Voltage Regulator	R40A1 – R40C1	
○ Control + Cabinet	R41A-R41C	
○ Universal Control, Adapter Panels	R42A – R42T	
○ Communication Cabinet	R43C	
○ Replacement Control Cable	R43GM-R43GS	
○ **Riser**		
• Leader – Nylon	UK49A – UK49B	
○ Reducer	UK14GF	
○ U-Guards - 5’ HDPE	UK11D – UK11H	
○ **Screw**		
• Lag Screw– Gimlet Point	B11A – B12	
○ Lag Screw– Fetter Or Twist Drive	B9 – B9N2	
○ U-Duct Lag Screw – Hex Head	B10B	
○ **Sensors, Line**		
• Power Sensor	SP1	
○ Power Sensor Collector Box	SP1A	
○ **Shackle**	C5A – C5C	
• **Sign** (see also **Label** or **Tag**)		

MATERIAL	STD ITEM	ILLUSTRATION
• Caution - Floating Wye/Delta Installation	P23F	
• Warning – Hand Dig Only	P23HD	
○ Caution - Loop Scheme	P23LS	
○ Clamp On	P21S	
○ Electric System Neutrals Separated	P22V	
○ Electrical Safety Designation - MA only.	P23B1 – P23B3	
○ Electrical Safety Designation	P23C1 – P23C2	
○ Notice - See Bulletin	P23CC	
○ Notice – Equipment Participates	P23CS	
○ Ground Grid Present	P23G	
○ Danger - Overhead Power Lines	P23OPL	
○ Notice – Supplemental PPE Required	P23S	
○ Control Communicates w/ Transmission Device	P23T	
○ Low Voltage Supply to Transmission Switch	P23T2	
○ Not In Phase	P22P	
○ Notice – Do Not Disconnect of Bypass	P22U	
○ **Spacer**		
• Secondary Open-Wire Spacer	A57A	
○ Spacer – Spacer Cable	A54C – A54CT	
○ Secondary Multiplex Spacer	A58B	
○ Conductor Phase Spacer	A59B	
○ **Spiral Wrap**	T15	
• **Splice**		
• Cold Shrink, 5-35kV, "All in One"	UR51A – UR51E	
○ Premolded – 15kV, #2 Aluminum	UR50	
○ **Staples – Galvanized Steel**	S33A – S33C	
• **Surge Arrester -** see **Arrester**		
• **Sweep, Galvanized Conduit, 90°**	UK31A – UK31H2	
• **Switch**		
• Enclosed Polymer Disconnect – 5kV	D1C	
○ In-Line – 15kV & 35kV	D3A – D4A	
○ Loadbreak Accessories	D7DS – D7M1	
○ Open Disconnect Switch	D5D – D5F	
○ 3Φ Gang-operated Loadbreak Switch	D7D – D7K	
○ Power Fuse – (Mounting) SMD – 5	C50A	
○ Regulator Bypass Switch	D8	

MATERIAL	STD ITEM	ILLUSTRATION
○ Subtransmission Switches and Loadbreaks	D7F, TS6H – TS2P2	
○ Vacuum Switch	C39B - C39BC	
• **Tape**		
○ Electrical – Black	T1B	
○ Electrical – Filler	T5E	
○ Electrical, Vinyl Plastic – Black	T2W1 – T2W2	
○ General Purpose Friction – Black	T1A	
○ Insulating	T5B – T5B6	
○ Plastic Sealer	T5D4	
○ Semiconducting	T1S	
○ Silicone Rubber	T5S1	
• **Tag** (see also **Sign** and **Label**)		
○ Nail	P20N – P20N2	
○ Name	P20A – P20B	
○ 1 ½” Number or Letter	P22A1 – P22A3	
○ 3” Number or Letter	P21A1 – P21A3	
○ Pole Tag Holder	P23E	
○ Rock Anchor Installed	P25	
○ Defective Pole Marker	P24	
○ Clearance and Control Tagging Kit	P30	
○ Letter	UP21L	
○ Number	UP21N	
• **Tag Holder**	UP21W – UP21W2	
• **Tee, PVC**	UK7T0	
• **Terminal Block**	NS4	
• **Terminations - Cold Shrink**	UR43-UR45C3	
• **Transformer**		
○ Adapter Plates – One Pair	T10	
○ Cluster Mount – 3 Phase	T9C – T9E	
○ Cold Shrink, 15kV, #2 Only	UR42 – UR42A	
○ Two piece steel bracket	T9AS	
○ Platform Mount	T6	
○ Single Phase, Pole Type	T91AA – T91HQS	
○ Single Phase, Pole Type, Auto	T91HR1 - T91HR2	

MATERIAL	STD ITEM	ILLUSTRATION
○ Single Phase, Ratio	T91J – T91	
• **Tubing**		
○ Heat Shrink	NT1 – NT3	
• **Washer**		
○ Belleville (Stainless Steel)	B8W10	
○ Curved – 2 ¼" Square	W4A	
○ Flat (Stainless Steel)	B8W2 – B8W3	
○ Flat	W8C – W8D	
○ Framing	NW4B – NW4C	
○ Ground Cup	NW4A	
○ Round	W5 – W8B	
○ Split (Stainless Steel)	B8W6 – B8W7	
○ Square Curved – Heavy	W2 –W3	
○ Square Flat – Standard	W1 – W1B	

ANCHOR, STEELWING SCREW

Galvanized steel construction with single thimble eye rod, 400 ft-lb. working torque rating, intended for hand installation.

HELIX DIAMETER	ROD	STD ITEM	SAP ITEM ID	PS ITEM ID
4”	¾” X 54”	A9	9313612[Y]	3503405[Y]

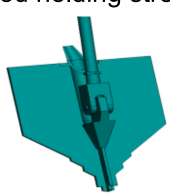
ANCHOR, BUST EXPANSION

Bust style expansion anchor, direct buried, 200 square inch surface area. To be used with ¾” or 1” diameter anchor rod (ordered separately). For use on distribution lines where equipment access is restricted.

EXCAVATION HOLE SIZE	ROD	STD ITEM	SAP ITEM ID	PS ITEM ID
10”	¾” X 54”	A9A	9388961	N/A
10”	1” X 54”	A9B	9325706	N/A

ANCHOR, MANTA RAY

Anchor, galvanized ductile iron, manta ray shape, per ASTM A-123 and A-153 with triple thimble eye rod. 1” rod holding strength is 3,6000 lbs. Shall be used in type soft and very soft soils only.



ROD	STD ITEM	SAP ITEM ID	PS ITEM ID
1” X 30”	A10A	9307981	N/A
1” X 53”	A10B	9388731	N/A
1” X 72”	A10C	9388730	N/A

ANCHOR, EXPANDING- ROCK

Coated malleable iron construction with triple thimble eye rod. 1” rod holding strength is 36,000lbs. Shall be used in type 0 soil (solid rock) only.

ROD	STD ITEM	SAP ITEM ID	PS ITEM ID
1” X 30”	A13A5	9313390	3503427
1” X 53”	A13A6	9313389	3503428
1” X 72”	A13A8	9313843	5980067

ANCHOR, POWER INSTALLED SCREW (PISA)

Coated steel soil anchors with hub tapped for 1" threaded anchor rods (STD ITEM A18).

HELIX DIA.	WORKING TORQUE RATING FT-LBS.	STD ITEM	SAP ITEM ID	PS ITEM ID
10"	10,000	A16A	9313466	3503608
14"	10,000	A16B	9314918	3503609

ANCHOR, POWER INSTALLED SCREW (PISA) (CONTINUED)

HELIX DIA	NOTES	WORKING TORQUE RATING FT-LBS.	STD ITEM	SAP ITEM ID	PS ITEM ID
4"	~ 36" Long rocky soils only	6,000	A16C	9307416	3503610

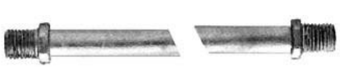
ANCHOR, PLANK

Treated 2" thick wood plank anchors. Pentachlorophenol treatment & retention shall be 0.3lb/ft^3.

LENGTH	WIDTH	HOLE	STD ITEM	SAP ITEM ID	PS ITEM ID
12"	8"	⅞"	A17A	9306951^{E}	5980102^{E}
15"	10"	1⅛"	A17B	9306950^{E}	5980103^{E}
24"	12"	1⅜"	A17C	9306949	5980104

ANCHOR, ROD (PISA)

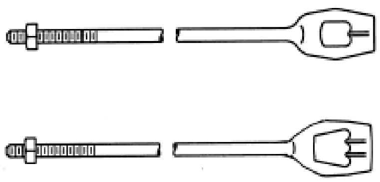
Galvanized steel rod, threaded (1") on both ends, with upset hex collars.



DIA.	LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
1"	3½' (42") (with coupling)	A18H	9313701	3503215
1"	7' (84")	A18K	9313700	3503217

ANCHOR, ROD

Galvanized steel rod, threaded (1") on one end, with upset hex collars.



DIA.	LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
1"	8'	A18N1	9319496[E]	5994810[E]
1"	10'	A18N2	9319495	5994845
1¼"	10'	A18N3	9319512	5994850

ANCHOR THIMBLE EYENUTS (PISA)

Galvanized ferrous tapped for standard 1" thread. For use with Item A18 Anchor Rods.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Triple Eye	A22J	9311875	3503227

ANCHOR – AUXILIARY EYE

Galvanized ferrous add-on thimble eye for existing ⅝" – ¾" anchor rods. Auxiliary eye adds additional guy attachment to existing anchor rods.

STD ITEM	SAP ITEM ID	PS ITEM ID
A24	9314850	0802835

CLAMP, SECONDARY / NEUTRAL SUPPORT

Galvanized malleable iron suspension clamp. Threaded body for ⅝" through bolt. 0.25" – 0.5" diameter cable range, provides 1½" pole offset.

0° - 30° Line Angles

STD ITEM	SAP ITEM ID	PS ITEM ID
A50B	9311777	3502812

CLAMP, MESSENGER / SHIELDWIRE

Galvanized medium duty aerial messenger clamp for spacer cable transposition installations.
⅝” mounting bolt, for 5/16” – ½” conductors.

STD ITEM	SAP ITEM ID	PS ITEM ID
A50BA	9320253	5986470

CLAMP, MESSENGER PERMANENT STRINGING ANGLE CLAMP

A combination stringing block and messenger clamp. Allows the messenger wire to be pulled in, tensioned and clamped using one piece of hardware. . For use when installing messenger wire on E brackets at max 60 angle. Cast steel, 20,000 max load rating.

.

STD ITEM	SAP ITEM ID	PS ITEM ID
A50BB	9388901	

CLAMP, AERIAL CABLE MESSENGER SUPPORT

Galvanized malleable iron suspension clamp for heavy angles on (4/0) aerial cable. Cable range of 3/8”– ¾” (0.375” – 0.75”).

Use ⅝” mounting bolts.

STD ITEM	SAP ITEM ID	PS ITEM ID
A50D	9311776	3502814

BRACKET, FIBER OPTIC CABLE

Galvanized bracket for ADSS fiber optic cable. Accepts diameter range of 0.876” – 0.925”

STD ITEM	SAP ITEM ID	PS ITEM ID
A50F	9393938	N/A

TANGENT BRACKET – SPACER CABLE SUPPORT

Tangent offset bracket for spacer cable applications. Bracket is supplied with a MC-2 messenger clamp.

STYLE	STD ITEM	SAP ITEM ID	PS ITEM ID
14” straight arm ductile iron	A50E1	9311775	3502815
24” upsweep arm aluminum	A50E2	9311782	3502766

U BOLT, GALVANIZED, SPARE, FOR SPACER CABLE E-BRACKET

Spare U-bolt, 9/16” diameter, galvanized steel, for use with spacer cable systems. U-Bolt is used to connect a messenger clamp (5986470) to E-Bracket (5974596).

STD ITEM	SAP ITEM ID	PS ITEM ID
A50G	9307952	9202821

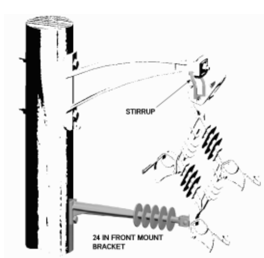
BRACKET, AERIAL CABLE EXTENSION ARM

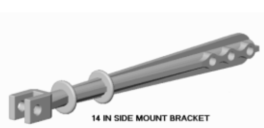
Galvanized steel aerial cable extension bracket. Heavy angle iron 44” offset from pole center.

STD ITEM	SAP ITEM ID	PS ITEM ID
A51B	9311781	3502767

14 IN & 24 IN ANTI-SWAY BRACKETS FOR SPACER CABLE

The 14 IN anti-sway bracket is side mounted to pole and used to stabilize spacers on tangent poles. The 24 IN anti-sway bracket is front mounted on face of pole and must be used with a stirrup on spacer on tangent poles. The brackets are injection molded proprietary, gray high density polyethylene and are supplied with a molded clevis pin for the attachment to a A54C & A54D spacer.





STYLE	STD ITEM	SAP ITEM ID	PS ITEM ID
14 IN	A54B	9306665	9201637
24 IN	A54B2	9307972	9202673
Stirrup for A54B2	A54B3	9386514	9203007

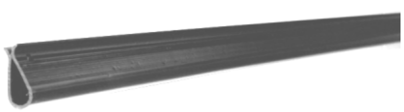
SPACER

Spacers with integral conductor / messenger clamps for spacer cable.

	RATING	SIZE	HEIGHT	WIDTH	STD ITEM	SAP ITEM ID	PS ITEM ID
	15KV				A54C	9311750	3502833
	46KV	22.7”	16.2”	3.2”	A54D	9307455[E]	5986980[E]
 Replacement elastic ring tie. MAINTENANCE ONLY					A54CT	9311854	3502853

MESSENGER COVER

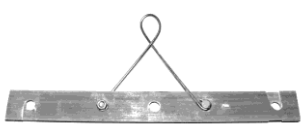
High density black polyethylene clip-on cover for spacer cable messenger installations.



SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
8’	A55	9307833	9202303

SPACER, SECONDARY OPEN-WIRE

Fiberglass spreader / spacer bracket for existing open-wire secondaries and services.



STD ITEM	SAP ITEM ID	PS ITEM ID
A57A	9311894	3502856

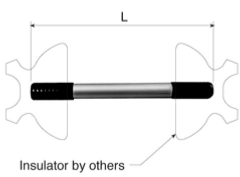
SECONDARY MULTIPLEX SPACER

U.V. resistant black or grey PE spreader / spacer for making mid-span service taps from multiplex secondaries.

STD ITEM	SAP ITEM ID	PS ITEM ID
A58B	9311938	2021965

CONDUCTOR PHASE SPACER

Conductor phase spacers for long spans in windy areas. Gray silicone rubber coated epoxirod with plastic coated aluminum threaded end fittings (1" threaded). Use with STD ITEM I6 insulators.



LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
48"	A59B	9314610	0810887

CABLE, AERIAL, 15kV – 35kV

3 phase preassembled, lashed aerial cable. Fully insulated and shielded for installation within the secondary area, for express or second-primary circuits. Jacketed Concentric Neutral cable with covered lashing tape. 5000 lb. design tension. 7/16” EHS copperweld messenger for 15kV - 23kV cables, ½” EHS copperweld messenger for 35kV cables.

Preferred Termination 15kV-23kV – UR44C
Preferred Splice 15kV-23kV – UR49A2

Preferred Termination 35kV – UR45C3
Preferred Splice 35kV – UR49C1 with UR49D

	INSULATION					
CONDUCTOR AWG / KCMIL	**THICKNESS**	**O.D.**	**STD REEL**	**STD ITEM**	**SAP ITEM ID**	**PS ITEM ID**
15kV - 4/0 cu	0.220"	1.03"	1000’	A60E	9315602	4020420
15kV – 500 al	0.175”	1.08”	1000’	A61GA	9386946	none
23kV – 350 al	0.260”	1.26”	1000’	A61FA	9315099	0808660
23kV – 500 cu	0.260”	1.39”	1000’	A61G	9315949	4033355
35kV – 2/0 cu	0.345”	1.115”	1000’	A62D	9315096^{Y}	0808825^{Y}
35kV – 350 cu	0.345”	1.42”	1000’	A62F	9314085^{Y}	0810635^{Y}
35kV – 500 cu	0.345”	1.56”	1000’	A62G	9306450	9201806

BAG, VINYL

Blue vinyl bag with handles to protect the OH Distribution Standards book.

STD ITEM	SAP ITEM ID	PS ITEM ID
A80B	9306753	9202164

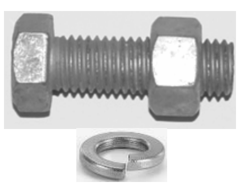
BOLT, MACHINE – ⅜" & ½"

Square head steel bolt (with nut) per ANSI Standards B18.2 and C135.1. Zinc coated in accordance with ASTM A135 or B695.

DIA	L	T	STD ITEM	SAP ITEM ID	PS ITEM ID
⅜"	4½"	3"	B1	9319838	7001537
½"	6"	3"	B3	9319829	7001590
½"	8"	4"	B4A	9316016	7001570
½"	2"	1¾"	B4B	9320575	5983120
½"	2½"	1¼"	B4C	9320574	5983124
½"	3½"	1¼"	B4D	9320635[E]	5981360[E]
½"	9"	4"	B4E	9320573	5983190

BOLT, MACHINE – GALVANIZED STEEL

Galvanized steel hex head bolt, nut and lock washer. Bolt and nut to be in accordance with ASTM A-394. Threads to be in accordance with ANSI B1.1, series UNC; Class 2A (bolts) and 2B (nuts). Lock washers shall be regular helical spring galvanized carbon steel.



DIA	LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
½"	1"	B5C10	9321525	7009501
½"	1½"	B5C15	9321425	7009503
½"	2"	B5C20	9321424	7009505
½"	3½"	B5C35	9321420	7009511
⅝"	2" (XMFR mounting)	B5C40	9320633	5981384
½"	Split washer	B5W7A	9321667	7006104
⅝"	Split washer	B5W7B	9306406[E]	5997270[E]

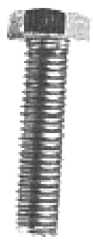
BOLT, CARRIAGE

Galvanized steel construction with corresponding nut.

DIA.	LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
½"	6"	B8A1	9307345[E]	5981154[E]
⅜"	4½"	B8A2	9306391	5981044
⅜"	6"	B8A2A	9305940	5106128
⅜"	7"	B8A3	9306974	5981070

BOLT, MACHINE – STAINLESS STEEL

Non-magnetic stainless steel construction manufactured of series 18-8 material (18% chromium, 8% nickel). UNC fully threaded up to 2”. Bolts longer than 2” have minimum thread length of 2”. The belleville washer is 301 stainless steel.

	NOTES	STAINLESS STEEL GRADE	DIA.	LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
	Hex Bolt	304	⅜”	1½”	B8B15	9303903	5622735
	Hex Bolt		⅜”	2”	B8B20	9303773	5622737
	Hex Bolt		⅜”	2 ¼”	B8B21	9391757	N/A
	Hex Bolt		⅜”	2 ½”	B8B25	9304693	5622740
	Hex Bolt		⅜”	2 ¾”	B8B27	9319746	7009300
	Hex Bolt		½”	1”	B8C10	9304788	5624913
	Hex Bolt		½”	1 ¼”	B8C12	9321512	7009310
	Hex Bolt		½”	1½”	B8C15	9304787	5624915
	Hex Bolt		½”	2”	B8C20	9304786	5624920
	Hex Bolt		½”	2½”	B8C25	9304785	5624925
	Hex Bolt		½”	3”	B8C30	9304784	5624927
	Hex Nut	316	⅜”	N/A	B8B40	9304774	5625193
	Hex Nut		½”	N/A	B8C40	9319754	7001719
	Flat Washer	304	⅜”	N/A	B8W2	9304688	5629591
	Flat Washer		½”	N/A	B8W3	9319831	7006021
	Split Washer	304	⅜”	N/A	B8W6	9304691	5629210
	Split Washer		½”	N/A	B8W7	9304690	5629229
	Belleville Washer	301	½”	N/A	B8W10	9319830	7006022

LAG SCREW

Steel lag screw with square head, shoulder shank, fetter or twist drive, and pilot/drive point. However, ⅝” doesn’t have a pilot/drive point. In accordance with NEMA PH3. Zinc coated in accordance with ASTM A153 or B695.

DIA.	LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
½”	4”	B9	9309115	7011833
⅜”	3”	B9N1	9307185	5995685
⅝”	4”	B9N2	9307177	5995825

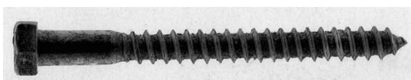
U-DUCT LAG SCREW

Galvanized steel lag screw with hex head, shoulder shank, and gimlet point with steel/neoprene washer. In accordance with ANSI B18.2.1. Zinc coated in accordance with ASTM A153 or B695. Standard U-duct fastener.

DIA.	LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
¼”	2”	B10B	9322030	7011830

LAG SCREW – GIMLET POINT - ⅜”

⅜” steel lag screw with square or hex head, shoulder shank and gimlet point. In accordance with ANSI B18.2.1. Zinc coated in accordance with ASTM A153 or B695.



LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
3”	B11A	9322026^{Y}	7011901^{Y}
4”	B11B	9322027	7011879

LAG SCREW – GIMLET POINT – ½” X 4”

½” steel lag screw with square head, shoulder shank and gimlet point. In accordance with ANSI B18.2.1. Zinc coated in accordance with ASTM A153 or B695.

STD ITEM	SAP ITEM ID	PS ITEM ID
B12	9322029	7011835

BOLT, MACHINE ⅝”

Square head steel bolt (with nut) per ANSI Standard C135.1. Zinc coated in accordance with ASTM A153 or B695. (Min. tensile strength 12,400 lbs.)

L	T	STD ITEM	SAP ITEM ID	PS ITEM ID
10”	4”	B13A	9315997	7001500
12”	6”	B13B	9320033	7001501
14”	6”	B13C	9309119	7001503
16”	6”	B13D	9320015	7001505
18”	6”	B13E	9320032	7001506
20”	6”	B13F	9320031	7001507
24”	6”	B13G	9319840	7001533
8”	4”	B13H	9319836	7001546
6”	3”	B13J	9320549	5983260
2”	1½”	B13K	9320550	5983220

BOLT, MACHINE ¾"

Square head steel bolt (with nut) per ANSI Standard C135.1. Zinc coated in accordance with ASTM A153 or B695. (Minimum tensile strength 18,350 lbs.)

L	T	STD ITEM	SAP ITEM ID	PS ITEM ID
8"	4"	B14A	9319834	7001555
10"	4"	B14B	9319841	7001530
12"	6"	B14C	9314896	7001556
14"	6"	B14D	9319846	7001520
16"	6"	B14E	9319786	7001521
18"	6"	B14F	9319844	7001522
20"	6"	B14G	9319837	7001540
2"	1¾" (XMFR mounting)	B14H	9307158	9200904

BOLT, DOUBLE ARMING ⅝"

Galvanized steel construction, ⅝" diameter, full threaded rod with (4) square nuts. Minimum tensile strength of 12,400 lbs. Manufactured per ANSI Standard C135.1. Zinc coated per ASTM 153 or B695.

L	STD ITEM	SAP ITEM ID	PS ITEM ID
16"	B15A	9320701	7002926
18"	B15B	9320034	7002925
20"	B15C	9321366	7002929
22"	B15D	9320702	7002930
24"	B15E	9321592	7002931
26"	B15G	9307343[E]	5981526[E]
28"	B15F	9321589	7002946
30"	B15H	9321588	7002949

BOLT, DOUBLE ARMING ¾"

Galvanized steel construction, ¾" diameter, full threaded rod with (4) square nuts. Manufactured per ANSI Standard C135.1. Zinc coated per ASTM 153 or B695.

L	STD ITEM	SAP ITEM ID	PS ITEM ID
20"	B16A	9321591	7002943
22"	B16A1	9307348	5981622
24"	B16A2	9321590	7002944
26"	B16B	9307340	5981626
28"	B16C	9307338	5981628
30"	B16D	9307337	5981630
32"	B16E	9320625	5981632

NUT, SQUARE

Galvanized steel ½ inch height square nut.

DIAMETER	STD ITEM	SAP ITEM ID	PS ITEM ID
5/8”	B17A	9319911	5993400
3/4”	B17B	9307167	5993410

BOLT, MACHINE 7/8”

Square head steel bolt (with nut) per ANSI Standard C135.1. Zinc coated in accordance with ASTM A153 or B695. (Minimum tensile strength 25,400 lbs.)

LENGTH	THREAD	STD ITEM	SAP ITEM ID	PS ITEM ID
8”	6”	B18A	9319753	7001927
10”	6”	B18B	9319752	7001928
12”	6”	B18C	9319998	7001453
14”	6”	B18D	9319997	7001454
16”	6”	B18E	9319996	7001455
18”	6”	B18F	9309341	7001456
20”	6”	B14G	9315707	7001488

BOLT EYE, THIMBLE EYELET

Galvanized ferrous eyelet, for use with preformed dead-ends (STD ITEM P52 & P54). NEMA standard PH5.

BOLT SIZE	BOLT HOLE DIMENSION	STD ITEM	SAP ITEM ID	PS ITEM ID
⅝”	11⁄16” X 1”	B20A	9313442	3503335
¾”	13⁄16” X 1⅛”	B20B	9313441	3503336

BOLT EYE, THIMBLE EYELET

Galvanized ferrous eyelet, for use with clevis and pin dead-end hardware. NEMA Standard PH5.

BOLT SIZE	BOLT HOLE DIMENSION	STD ITEM	SAP ITEM ID	PS ITEM ID
⅝”	11⁄16” X 1”	B21B	9313558	3503116
¾”	13⁄16” X 1⅛”	B21C	9313557	3503117

EYENUT, STANDARD

Hot-dipped galvanized (ASTM 153-73) steel. Threads onto standard bolt thread for retro-extensions of dead ended poles. Use with clevis and pin hardware. NEMA Standard PH5 Type I.

BOLT SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
⅝”	B22B	9313440	3503338
¾”	B22C	9313418	3503339

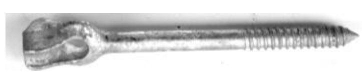
BOLT EYE SHOULDER, OVAL

¾” Diameter, 10 UNC threads, galvanized steel construction with a square nut.

LENGTH	THREAD LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
12”	3¼”	B32A	9320620	5982312
14”	6½”	B32B	9320619	5982314

BOLT EYE, SCREW THIMBLEYE

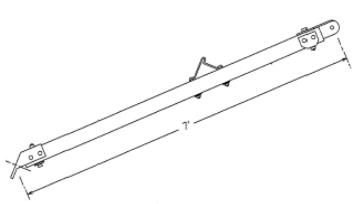
⅝” Diameter, 6¾” length, galvanized steel construction with a 3” thread length.



STD ITEM	SAP ITEM ID	PS ITEM ID
B33A	9307332[E]	5984035[E]

BRACE, ALLEY ARM

Brace, wood alley arm, 2¾” X 3½” straight grained Douglas Fir with hot dip galvanized steel end fittings and step bracket. 11⁄16” mounting holes. For use with standard 8’ & 10’ crossarms.



DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
7’ Brace Hole Spacing (for 8’ crossarms)	B36	9315257	0807179
10’ Brace Hole Spacing (for 10’ crossarms)	B36B	9306514	9201695

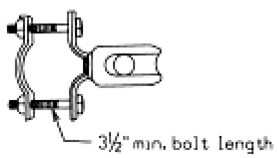
BRACE, FLAT WOOD CROSSARM – ONE PAIR

1" X 1¾" treated wood section with aluminum or galvanized steel end fittings. 26" center-to-center between one 7/16" d. and one 9/16" d. end bolt holes (each brace). Approximately 4 lbs. each pair.

STD ITEM	SAP ITEM ID	PS ITEM ID
B37B	9314904	0810389

BRACKET, INSULATED SERVICE

Reinforced light grey, grey or black nylon wire holder. For multiplex service attachment to metal mast. 1200 lb. minimum tensile strength, 500 lb. minimum cantilever.



DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
For 1¼" – 2½" Pipe	B53A	9311502[Y]	3502100[Y]
For 3" – 4"Pipe	B53B	9311479[Y]	3502104[Y]

BRACKET, INSULATED SERVICE

Reinforced grey nylon wire holder with 4" X #22 (approx. 5/16") hot dip galvanized wood screw, for attachment of light overhead service drop cables to a building.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Wire Holder	B54	9311501	3502101
Installation Tool	B54T	9387915	*none*

LINK – FIGURE 8

Forged steel, hot-dip galvanized 30,000 lbs. ultimate. Approximately ¾ lb. each.

STD ITEM	SAP ITEM ID	PS ITEM ID
C4A	9312414	3506171

LINK, TRANSMISSION CHAIN

Galvanized steel pitch, line end hardware, 3 ½" X 2 ½", 1" opening, 60 M ultimate strength.

STD ITEM	SAP ITEM ID	PS ITEM ID
C4B	9314320	0810536

SHACKLE

Steel construction with a bolt, nut, or a ⅝" clevis pin and cotter pin.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
18,000 lb. ultimate	C5A	9312424	3504444
30,000 lb. ultimate	C5B	9307405	5987580
60,000 lb. ultimate	C5C	9307404	5987592

CLEVIS, THIMBLE

⅞" Galvanized steel construction, 20,000 lbs. max load rating, ⅝" pin.

STD ITEM	SAP ITEM ID	PS ITEM ID
C5D	9307409[E]	5987620[E]

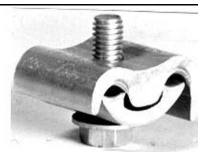
CONNECTOR VISE

For copper-to-copper connections. Each connector will accept two of the conductors listed below and any combination in between.

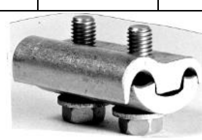
MAX. WIRE SIZE		STD ITEM	SAP ITEM ID	PS ITEM ID
SOLID	STRAND			
6	8	C6N1	9320125	5963920
4	4	C6N2	9320124	5963930
2	3	C6N3	9320123	5963935
1	2	C6N4	9320122	5963940
2/0	1/0	C6N5	9320412	5963945
3/0	2/0	C6N6	9308891[E]	5103923[E]
4/0	4/0	C6N7	9320121	5963955
500	500	C6N8	9389771	

CONNECTOR, PARALLEL GROOVE

Aluminum body non-tension bolt type connector for aluminum-to-aluminum or aluminum-to-copper cable. Connectors are pre-filled with inhibiting grease and individually packaged; shall meet ANSI C119.4 Class A Class 3 latest revision.



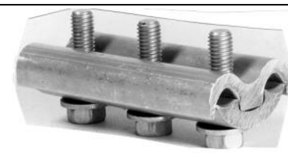
BOLT SIZE	GROOVE A			GROOVE B			STD ITEM	SAP ITEM ID	PS ITEM ID
	ALUM. OR CU.	ACSR, AWAC, 5005, 6201	WIRE DIA. RANGE	ALUM. OR CU.	ACSR, AWAC, 5005, 6201	WIRE DIA. RANGE			
5⁄16”	8 - 2	6 - 2	0.128” – 0.325”	8 - 2	6 - 2	0.128” – 0.325”	C7A	9320570[E]	5962820[E]
⅜”	6 – 2/0	6 – 2/0	0.162” – 0.447”	6 – 2/0	6 – 2/0	0.162” – 0.447”	C7B	9312212	3506863
½”	4/0 – 400.0	3/0 – 336.4	0.464” – 0.743”	6 – 2/0	6 – 2/0	0.162” – 0.447”	C7D	9312219	3506864
⅝”	450.0 – 1000.0 Al. & 450.0 – 500.0 Cu.	477.0 – 795.0	0.743” – 1.152”	6 – 3/0	6 – 2/0	0.162” – 0.464”	C7DA	9320569	5962841



⅜”	2 – 3/0	2 – 3/0	0.292” – 0.502”	2 – 3/0	2 – 3/0	0.292” – 0.502”	C7E	9320568	5962850
½”	4/0 – 400.0	3/0 – 336.4	0.464” – 0.743”	2 – 3/0	2 – 3/0	0.292” – 0.502”	C7G	9320567	5962860
⅝”	450.0 – 1000.0 Al. & 450.0 – 500.0 Cu.	477.0 – 795.0	0.743” – 1.152”	4/0 – 400.0	3/0 – 336.4	0.464” – 0.743”	C7H	9320566	5962875

CONNECTOR, PARALLEL GROOVE (CONTINUED)

Aluminum body non-tension bolt type connector for aluminum-to-aluminum or aluminum-to-copper cable. Connectors are pre-filled with inhibiting grease and individually packaged; shall meet ANSI C199.4 Class A Class 3 latest revision.



BOLT SIZE	GROOVE A			GROOVE B			STD ITEM	SAP ITEM ID	PS ITEM ID
	ALUM. OR CU.	ACSR, AWAC, 5005, 6201	WIRE DIA. RANGE	ALUM. OR CU.	ACSR, AWAC, 5005, 6201	WIRE DIA. RANGE			
½"	4/0 – 400.0	3/0 – 336.4	0.464" – 0.743"	4/0 – 400.0	3/0 – 336.4	0.464" – 0.743"	C7I	9302658	5962870
⅝"	450.0 – 1000.0 Al. & 450.0 – 500.0 Cu.	477.0 – 795.0	0.743" – 1.152"	450.0 – 1000.0 Al. & 450.0 – 500.0 Cu.	477.0 – 795.0	0.743" – 1.152"	C7J	9320411	5962880

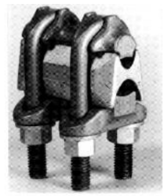
CONNECTOR - PARALLEL GROOVE, COPPER

For copper-to-copper connections. Interlocking finger design provides firm grip with maximum contact length.

CONDUCTORS (EITHER GROOVE)	STD ITEM	SAP ITEM ID	PS ITEM ID
4 Sol. – 4/0 Str.	C7K	9320554	5962562
4/0 Str. – 500.0	C7L	9320555[E]	5962570[E]

CONNECTORS - "U" BOLT

Alternate type connectors for large wire sizes.

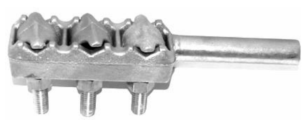


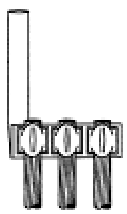
BOLT SIZE	GROOVE A			GROOVE B			STD ITEM	SAP ITEM ID	PS ITEM ID
	ALUM. OR CU.	ACSR, AWAC, 5005, 6201	WIRE DIA. RANGE	ALUM. OR CU.	ACSR, AWAC, 5005, 6201	WIRE DIA. RANGE			
½"	4/0 - 400.0	3/0 - 336.4	0.464" - 0.743"	4/0 - 400.0	3/0 - 336.4	0.464" - 0.743"	C7M	9320565[E]	5962920[E]
⅝"	450.0 - 1000.0 Al & 450.0 - 500.0 Cu	477.0 - 795.0	0.743" - 1.152"	4/0 - 400.0	3/0 - 336.4	0.464" - 0.743"	C7N	9320564	5962925
⅝"	450.0 - 1000.0 Al & 450.0 - 500.0 Cu	477.0 - 795.0	0.743" - 1.152"	1/0 - 3/0	2 - 3/0	0.292" - 0.502"	C7P	9303004[E]	5962924[E]

⅝"	450.0 - 1000.0 Al & 450.0 - 500.0 Cu	477.0 - 795.0	0.743" -1.152"	450.0 - 1000.0 Al & 450.0 - 500.0 Cu	477.0 - 795.0	0.743 - 1.152	C7Q	9320563	5962930
¾"		1113 ACSR	1.140" – 1.340"		1113 ACSR	1.140" – 1.340"	C7R	9303014	5962940

CONNECTOR, SECONDARY TERMINAL ADAPTER

Secondary terminal adapter for overhead distribution transformers; provides multiple eyebolt terminals at transformer secondary. Bronze construction, for use with #1/0 (0.321") through 500 MCM (0.813") copper conductors.

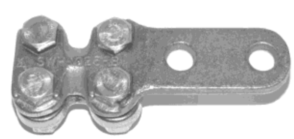




NUMBER OF TERMINALS (TAPS)	STD ITEM	SAP ITEM ID	PS ITEM ID
2	C8A	9311884	2014912
3	C8C	9311883	2014913
4	C8E	9311882	2014914
2	C8B	9311895	2014902
3	C8D	9311887	2014903
4	C8F	9311885	2014904

CONNECTOR – BRONZE TERMINAL LUG

Bronze terminal, (2) hole, 1½" X 3" flat pad, no insulation. Use on airbreak / loadbreak switches, transformers, disconnect switches or on any connection from copper to flat copper pad or bus bar.



RANGE		NUMBER OF BOLTS	HOLES IN PAD	STD ITEM	SAP ITEM ID	PS ITEM ID
CONDUCTOR	INCHES					
#4 – 250	.204 - .575	2	2	C8N1	9320350	5965885
1/0 – 500	.325 - .813	2	2	C8N2	9320349	5965889
1/0 – 500	.325 - .813	2	4	C8N3	9311474	3506467

CONNECTOR – TERMINAL LUG

Standard NEMA 2-hole tinned aluminum or copper terminal lug. 46 kV and below, ANSI C119.4, Class A Class 2 minimum. Aluminum connectors shall be compound filled and capped.

CABLE SIZE		L (IN.)	CRIMPING TOOL / DIE / # OF CRIMPS						STD ITEM	SAP ITEM ID	PS ITEM ID
			MD6		Y34A	Y34PR	Y35 OR Y39				
			DIE	#/CR.	NEST	INDENT	DIE	#/CR.			
COPPER	#2	4.8	W162	4	A2CD	1	U2CRT	2	C9A	9311388	3506429
	#1/0	4.9			A25D	1	U25RT	2	C9B	9311381	3506426
	#2/0	5			A26D	1	U26RT	2	C9B1	9309141	3506463
	#4/0	5.4					U168	2	C9C	9311409**	3506453**
	350	5.8			A31D	2	U31RT	4	C9D	9311399	3506431
	500	6			A34D	2	U34RT	4	C9E	9311400	3506432
	750	7					U39RT S39RT P39RT	*4	C9E1	9311480	3506485
ALUMINUM	#2	5.0	W243	3	A243	3	U243	2	C9H	9311663	3506401
	#1/0 Al. or ACSR	5.3 – 6.3	BG WBG	8 4			UBG	4	C9J	9311417[Y]	3506433[Y]
	#2/0	5.5 – 6.5	W245	5			U245	2	C9K	9311664[Y]	3506400[Y]
	#3/0	5.5 – 6.8	W247	5			U247	3	C9P	9311389[Y]	3506404[Y]
	#4/0	6.0 – 6.9					U249	3	C9M	9311662[Y]	3506402[Y]
	336.4 – 350 Al or ACSR	6.5 – 7.6					U655	3	C9L	9311416[Y]	3506434[Y]
	500	6.8 – 8.1					U34ART	4	C9G	9311415	3506436
	750	7.4 – 8.3					U39ART	*4	C9N	9311387	3506405

* Do not use Y35 tool. Need 15 ton tool

** Use this terminal lug for switches and disconnects. Otherwise, use Std Item UL15E (Item ID 9201251). See UG Material Catalog, Section 50, for more information on UL15E.

NOTES:

1.) *In **Y45** tool use Y35 die with "S" adapter (Burndy Cat. No. PT-6515).*
2.) *In **Y46** tool use Y35 die with "P" adapter (Burndy Cat. No. P-UADP).*
For 1000 MCM connector (non-standard) use Y45 / S44ART or Y46 / P44ART (4 Crimps).

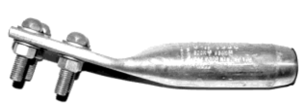
CONNECTOR – TINNED ALUMINUM TERMINAL LUG

Standard NEMA 2-hole tinned aluminum terminal lug. For large size 600-900 MCM stranded aluminum or copper conductors. Terminal lug to be in accordance with ANSI C119.4 Class A, Class 2 minimum. For use on airbreak / loadbreak switches, transformers, disconnect switches, or on any connection from aluminum cable to flat aluminum or copper pad or bus bar.

RANGE		NUMBER OF BOLTS	HOLES IN PAD	STD ITEM	SAP ITEM ID	PS ITEM ID
CONDUCTOR	INCHES					
600 – 900	0.870 – 1.108	4	2	C9F	9314937	3506435
1/0 – 4/0	0.368 – 0.563	2	2	C9FA	9320295[E]	5966418[E]
300 – 500	0.630 – 0.813	2	2	C9FB	9313203[E]	5966422[E]
250 – 400	0.575 – 0.728	2	4	C9FC	9313205[E]	5966419[E]
450 – 1000	0.743 – 1.152	3	4	C9FD	9313204[E]	5966420[E]

CONNECTOR – TERMINAL

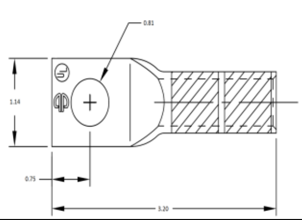
4 hole flat pad to cable electrical terminal connector with a 15˚ pad. Aluminum termination end, inhibitor loaded.



CONDUCTOR		STD ITEM	SAP ITEM ID	PS ITEM ID
SIZE	PAD WIDTH			
795 ACSR 54/7 CONDOR	3”	C9FE	9310811	5105654
1113 ACSR 54/19 FINCH	3”	C9FF	9310818	5105655

CONNECTOR – TERMINAL LUG - GROUNDING

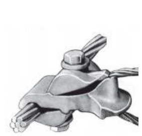
For connected #4 solid copper to ¾” insulator stud.



STD ITEM	SAP ITEM ID	PS ITEM ID
C10	9392017	N/A

CLAMP, STRAIN

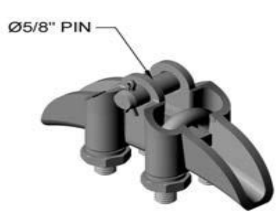
Deadend clamps for distribution construction with copper, CCW, aluminum, or ACSR conductors.

	MATERIAL	CAPACITY (lbs)	DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
	Galv. Mal. Iron	5,000	#6 to #2 Cu. #6A to #2A CCW	C13A1	9315731	3506760
	Galv. Mal. Iron	9,000	* #2 to 4/0 Cu. #6A to 2A CCW	C13A2	9312434	3504158
	Galv. Mal. Iron	10,000	#4/0 to 400kcmil Cu.	C13B	9315732[Y]	3506758[Y]
	Aluminum	6,000	* #4 to 2/0 Al. or #6 to 2/0 ACSR	C13H	9315730	3506763
	Aluminum	8,000	* 3/0 to 556.5 Al. or 2/0 to 556.5 ACSR	C13J	9307352	5985783
	Aluminum	15,000	3/0 to 477 Al. or 336.4 to 1000 ACSR	C13K	9307354	5985564
	Galvanized Steel	15,000	.25-.5" galv. steel or #4 to 4/0 Cu.	C13L	9307353	5985605
	Aluminum	35,000	397.5 to 1431 Al. or 336.4 to 1272 ACSR	C13M	9320354	5985660
	Aluminum	15,000	336.4 – 1000 Al.	C13N	9307359	5985784
	Aluminum	15,000	336.4-1200 Al. or 336.1-1113 ACSR	C13O	9393955	N/A
	Galv. Mal. Iron	8,000	2/0 solid to 4/0 Cu. & copperweld	C13P	9307369[E]	5985905[E]
	Aluminum	-	1/0 secondary neutral to service messenger mid-span clamp	C13S	9308334	9201457
	Aluminum	1,250	1/0 to 2-4 AWG Al service and neutral	C13Q	9307433	

** Side opening / Hot stick type clamp*

SUSPENSION CLAMP

For use on sub-transmission construction.



MATERIAL	CAPACITY	MAX. TAKE-OFF ANGLE	CLAMPING RANGE	STD ITEM	SAP ITEM ID	PS ITEM ID
Aluminum	18,000 lbs.	60˚	0.40”-0.85”	C14A	9312402	3504550
Aluminum	25,000 lbs.	45°	0.90”-1.39”	C14B	9312470	3504562
Aluminum	25,000 lbs.	45°	1.00”-1.82”	C14C	9307357	5985330

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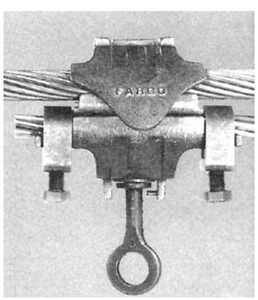
SUSENSION CLAMP, ANGLE

For use on messenger and distribution primary angle construction.


MATERIAL	CAPACITY	MAX. TAKE-OFF ANGLE	CLAMPING RANGE	STD ITEM	SAP ITEM ID	PS ITEM ID
Aluminum	5,000 lbs.	> 20˚	#4 ACSR – 336.4 Alum.	C15A	9313879	3504015
Galvanized Steel	7,000 lbs.	60°	0.16” – 0.60”	C15B	9307362	5985120
Galvanized Ductile Iron	11,000 lbs.	80°	0.16” – 0.75”	C15C	9307361	5985125

CONNECTOR, HOT LINE

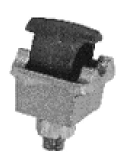
Vice type hot line connectors. Furnished inhibitor loaded and individually packaged in a plastic bag. Connector shall be in accordance with ANSI C119.4 Class A minimum.



MATERIAL	CABLE RANGE	STD ITEM	SAP ITEM ID	PS ITEM ID
Al (600A)	336.4 Al or ACSR Run to 336.4 Al or ACSR Tap	C16C	9312649	3504027
Al	477 Al Run to #3 Cu – 2/0 Al or Cu Tap	C16D	9313037[E]	5960228[E]
Al	336.4 Al - 477 Al, 795 Al Run to #3 Cu – 4/0 Al or Cu Tap	C16E	9313038	5960226
Al	477 Al Run to 477 Al Tap	C16F	9313036[E]	5960235[E]
Al	795 Al Run to 336.4 Al – 795 Al Tap	C16G	9313034	5960270

CONNECTOR, PRESSURE EYEBOLT (CABLE TO FLAT)

Outdoor heavy duty, pressure eyebolt connector, copper alloy body with a high strength bronze eyebolt, with ½” – 13 UNC threaded stud, lock washer and nut. For use with copper conductors and for mounting directly to a ¼” maximum thickness, flat surface.



CABLE RANGE	STD ITEM	SAP ITEM ID	PS ITEM ID
#8 solid – 2/0 stranded	C17B	9316651[Y]	2014802[Y]
#6 solid – 250 kcmil	C17D	9316645[Y]	2014846[Y]
1/0 solid – 500 kcmil	C17F	9316652	2014800

CLEVIS, THIMBLE

Galvanized steel or malleable iron, 18,000 lbs. ultimate, for use with preformed dead-ends (P52).

STD ITEM	SAP ITEM ID	PS ITEM ID
C20	9312544	3504055

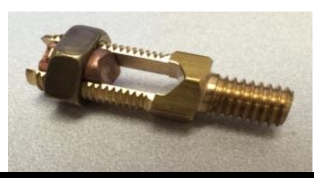
CONNECTOR, GROUND, VISE

Bronze vise-type grounding connector for copper conductors. For street lighting poles, bases and transformer tanks. ** Item C23B supplied with locknut on stud.*

CABLE RANGE	STD ITEM	SAP ITEM ID	PS ITEM ID
#6 Solid – #1/0 Stranded	C23A	9312543	3504058
#3 Solid – #4/0 Stranded.	C23B	9312542[Y]	3504059[Y]

CONNECTOR, GROUND, SPLIT BOLT

Copper, split bolt type, grounding connector for copper conductors. To be used to connect padmounted transformer grounds and bonding wires.



CABLE RANGE AWG	STD ITEM	SAP ITEM ID	PS ITEM ID
#2 sol. – #2/0 Str.	C24	9313780	5961547

CONNECTOR, HOT LINE - ALUMINUM

Clamp type plated aluminum hot line tap connector for copper and aluminum.

RUN	TAP	CURRENT RATING	STD ITEM	SAP ITEM ID	PS ITEM ID
1/0 Al or ACSR	#3 Cu - 1/0 Al or Cu	200A	C24A	9313040[E]	5960210[E]
4/0 Al, 336.4 Al, or ACSR	#3 Cu - 1/0 Al or Cu	200A	C24A1	9313039[E]	5960215[E]
#6 – 400	#6 – 4/0	230A	C24B	9313393	3504025
#4 – 336.4	#4 – 336.4	600A	C24C	9313392[Y]	3504026[Y]
4/0 - 800	#4- 350	524	C24CC	9386558	9203022

CONNECTOR, HOT LINE - BRONZE

Clamp type bronze hot line tap connector for copper to copper connections. Primarily used for 25kV and 35kV unless specified by specific standard.

RUN	TAP	STD ITEM	SAP ITEM ID	PS ITEM ID
400-6 solid	4/0-6 solid	C24D	9313035	5960240

CLAMP, CROSBY TYPE OR ROPE CLIP

Galvanized steel for guy strand.

WIRE SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
½”	C25B	9319634[Y]	8020676[Y]
⅝”	C25C	9319633[Y]	8020677[Y]
¾”	C25D	9319632[Y]	8020678[Y]

CONNECTOR, SERVICE

Non-tension bolted connector, aluminum bodied with inhibiting compound for aluminum-to-aluminum or aluminum-to-copper.

CABLE RANGE	STD ITEM	SAP ITEM ID	PS ITEM ID
#2 to 500 MCM	C26	9315845[Y]	3506843[Y]

CONNECTOR, SPLIT BOLT OR TWO BOLT TYPE

For copper or copperweld connections. Connectors can accommodate two of the following conductors of the same size or one of the following maximum size conductors and the minimum tap allowed.

CONDUCTOR RANGE	MIN TAP	STD ITEM	SAP ITEM ID	PS ITEM ID
#8 Sol. Cu. & #10 Str. Cu.	#14 Str. Cu	C27A	9316628	2014474
#6 Sol. Cu. & #8 Str. Cu.		C27A1	9316630	2014471
#6 Str. Cu.		C27A2	9316660[Y]	2014673[Y]
#4 Sol. Cu., #8 Str. Cu. & 6A CCW		C27B	9316629	2014472
#2 Sol. Cu. & #4 Str. Cu.		C27B1	9316625[Y]	2014479[Y]
#2 Str. Cu., #6 Str. Cu. & 4A CCW		C27C	9316704	2014499
#1/0 Str. Cu., #4 Str. Cu. & 2A CCW		C27D	9316627	2014475
#2/0 Str. Cu. & #2 Str. Cu.		C27E	9316624	2014496
#4/0 Str. Cu. - #1/0 Str. Cu.	#10 Str. Cu.	C27F	9316641	2014497
#350 MCM Str. Cu.		C27G	9316661	2014662
#500 MCM Str. Cu.		C27H	9316659[Y]	2014675[Y]

CONDUIT AND FITTINGS – 1” PVC

Rigid grey PVC conduit for indoor or outdoor applications. See STD ITEM UK6S for PVC cement

SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
1” X 10’ Straight Section	C29E10	9316094	2010253
1” PVC COUPLING	C29H	9317925	
1” PVC FEMALE TERMINAL ADAPTER	C29G	9388418	
1” PVC MALE TERMINAL ADAPTER	C29F	9320801	

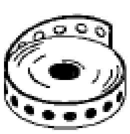
1” NON- METALLIC FLEX CONDUIT AND FITTINGS

PVC- UV resistant for indoor or outdoor applications

SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
1” X 100’ coil	C29B	9388351	
1” Non-Metallic Connector for use with non-metallic liquid-tight conduit, type B only	C29C	9388352	
4” X 250’ coil	C29L	9388737	

STRAP, PREFORATED

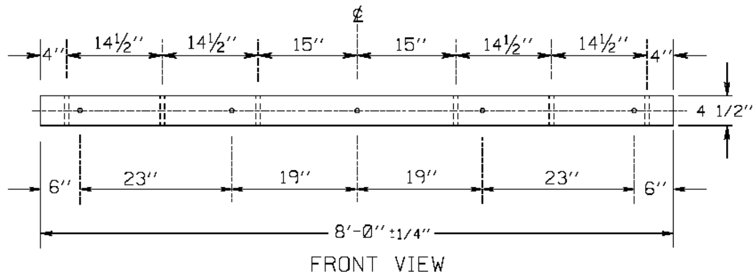
¾” wide X 20 gauge (0.35” thick) galvanized steel with ¼” to 9⁄32” d. Holes centered along the strap on ½” to ⅝” centers.



SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
50 Ft. Roll	C30	9321416[Y]	7503017[Y]

CROSSARM, 6 PIN STANDARD DUTY

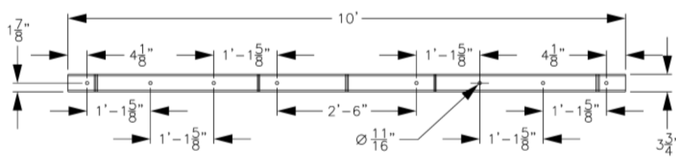
3½” x 4½” x 8’ Douglas Fir, pentachlorophenol treated per latest MS 2121.



STD ITEM	SAP ITEM ID	PS ITEM ID
C31B	9315007	3502022

CROSSARM, 8 PIN HEAVY DUTY

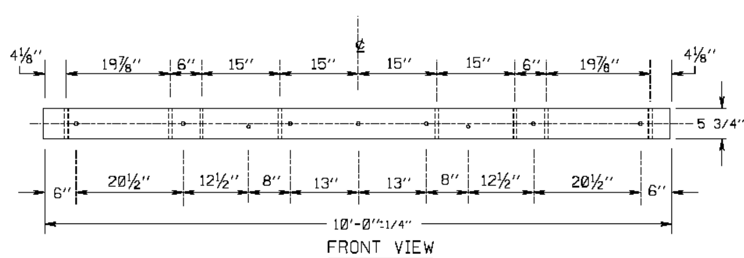
3¾” x 4¾” x 10’ Douglas Fir, pentachlorophenol treated per latest Spec. MS 2121. Used with STD ITEM TB60 (wood) braces for 3000 lb. construction dead-ends.



STD ITEM	SAP ITEM ID	PS ITEM ID
C31C	9306952	5980390

CROSSARM, 6 PIN HEAVY DUTY

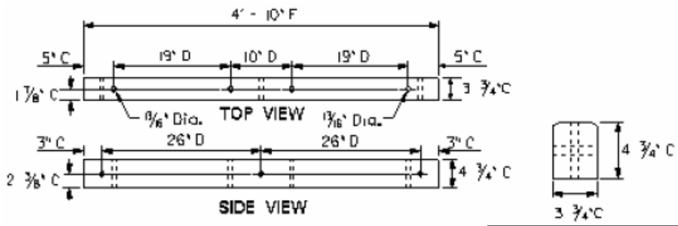
4¾” x 5¾” x 10’ Douglas Fir, pentachlorophenol treated per latest Spec. MS 2121. Used with STD ITEM TB60 (wood) braces for 3000 lb. construction dead-ends.



STD ITEM	SAP ITEM ID	PS ITEM ID
C31D	9311780	3502782

CROSSARM, 2 PIN HIGH TENSION ARM

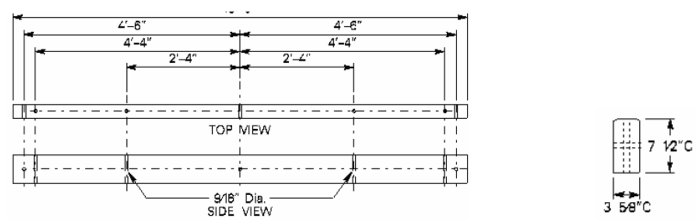
3¾” x 4¾” x 4’-10” Douglas Fir, pentachlorophenol treated per latest Spec. MS 2121 for distribution supply installations.



STD ITEM	SAP ITEM ID	PS ITEM ID
C31E	9306946[E]	5980350[E]

CROSSARM, 2 PIN HIGH TENSION ARM

3⅝” x 7½” x 10’ Douglas Fir, pentachlorophenol treated per latest Spec. MS 2121 for distribution supply installations.



STD ITEM	SAP ITEM ID	PS ITEM ID
C31F	9306945[E]	5980370[E]

CROSSARM, UNDRILLED HIGH TENSION ARM

8” x 4” x 14’ Douglas Fir, pentachlorophenol treated per latest Spec. MS 2121 for distribution customer substations & two pole highway crossings.

STD ITEM	SAP ITEM ID	PS ITEM ID
C31G	9309735	5475852

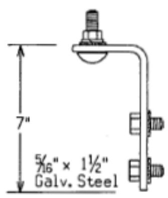
CROSSARM, UNDRILLED, TRANSFORMER / REGULATOR BANK

3-5/8” x 7-1/2” x 18 foot long Douglas Fir, pentachlorophenol treated per latest Spec. MS 2121. For support of insulators and disconnects associated with transformer and regulator bank platform installations.

STD ITEM	SAP ITEM ID	PS ITEM ID
C31H	9388772	9388772

BRACKET, ARRESTER

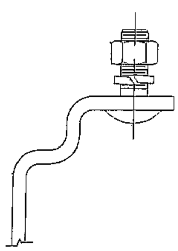
Galvanized steel offset bracket for mounting surge arresters on transformer or regulator tanks. Includes two ½" X 1" stainless steel hex head bolts with retaining-clip washers and one galvanized ½" X 2" captive carriage bolt, shake proof washer, lock washer and hex nut.

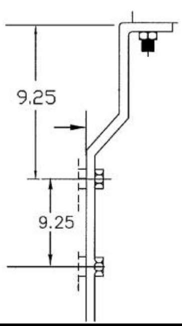


STD ITEM	SAP ITEM ID	PS ITEM ID
C32	9314509	0811170
C32B	9307170	9200115

BRACKET, ARRESTER

For pole type transformer with arrester rated at greater than 24kV, per ANSI Standard C57.12.20.

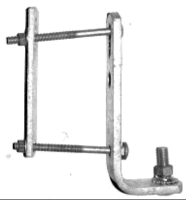




HEIGHT	STD ITEM	SAP ITEM ID	PS ITEM ID
16.75 inches	C32F	9307171[E]	9200114[E]
20.0 inches	C32G	9306590[E]	9201732[E]

BRACKET, CUTOUT / ARRESTER

Galvanized steel construction, for mounting an arrester or cutout onto crossarms, ANSI C37.42. C33 (left picture) is for mounting a single arrester or cutout on a wooden crossarm. C33A (right picture) is for an arrester and a cutout mounted on a fiberglass deadend crossarm (C76D).




STD ITEM	SAP ITEM ID	PS ITEM ID
C33	9311948	3502149
C33A	9387997	N/A

BRACKET, CUTOUT / ARRESTER

12” galvanized bracket for mounting cutouts, arresters, or terminators on a pole.


DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Single Position	C35	9320108	5984503
Three Position (For mounting a cutout & arrester)	C35A	9311015	5102584

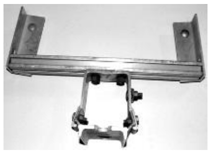
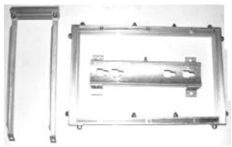
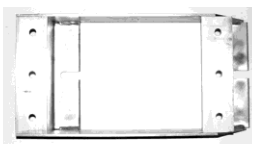
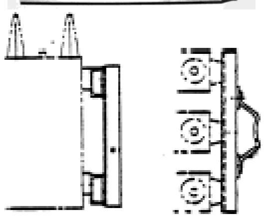
ASSEMBLY, CAPTIVE BOLT

2” X ½” captive bolt assembly package for equipment mounting. Use with STD ITEM C35.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
(1) 2” X ½” Captive Bolt (1) Lock washer (1) Star washer (1) Flat washer (1) Retaining clip (1) Nut	C35B	9309818	5105184

HANGER, CAPACITOR

Galvanized steel or aluminum construction with lightning arrester provisions.

FOR SINGLE PHASE UNITS: FOR CROSSARM OR POLE MOUNTING			
DESCRIPTION	**STD ITEM**	**SAP ITEM ID**	**PS ITEM ID**
For mounting a 1Φ Unit ONLY	C36A	9311947	3502160
For mounting up to three 1Φ Units	C36B	9311946[Y]	3502161[Y]
FOR THREE PHASE UNITS: FOR CANTILEVER POLE MOUNTING			
One or two 3Φ Units	C36C	9311945[Y]	3502162[Y]
Three 3Φ Units	C36D	9311944[Y]	3502163[Y]

GAIN, CROSSARM

For use between pole and cross arms. Galvanized iron per ANSI C135.33.


DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
3" X 4" For use between pole and cross arm at 30° to 60° dead-ends.	C37	9311443	3502243
For use with distribution supply wood crossarms or four inch channel arms, channel flanges can be turned up or down. 6" – 12" pole range, ¾" max. mounting bolt.	C37A	9307195	5988935

BRACKET, DISCONNECT MOUNTING

Galvanized steel construction, 30° disconnect mounting.

STD ITEM	SAP ITEM ID	PS ITEM ID
C38A	9309202	5100178

BRACKET, 600A DISCONNECT

Galvanized disconnect switch mounting bracket per MS2760. For 15kV-35kV, 600A open type single stick operated disconnect switches.

STD ITEM	SAP ITEM ID	PS ITEM ID
C38B	9307448	5984552

SWITCH, CAPACITOR TIME CONTROL

Capacitor time control with temperature and voltage override. Control includes a 4 stab meter base with mounting ring, extra large hole in the locking hasp and a screw hinge. Per MS2853.

STD ITEM	SAP ITEM ID	PS ITEM ID
C39A	9302641	5676370

SWITCH, ADVANCED CONTROL

Capacitor control for voltage, power factor, current and VAR sensing STD. Item C39A1. Communication capable with independent phase switching capability and neutral current detection capability per MS 2855.

Feeder monitor control Std. Item C39A2. Measures voltage, power factor, current or KVAR. Uses 120 volt input.

STD ITEM	SAP ITEM ID	PS ITEM ID
C39A1 C39A2	9307910 9391768	9202850 na

SWITCH, VACUUM

VERSAVAC vacuum switch assembly for switched capacitor banks. 200 Ampere continuous current rating, 100ms recommended control pulse time, 5 pin environmental connector, 120 VAC control voltage with manual trip lever.

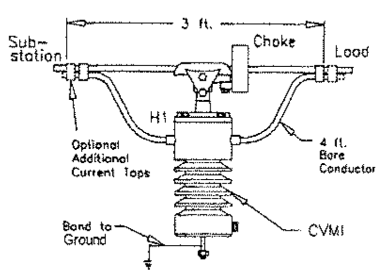
VOLTAGE	APPLICATION	BIL	STD ITEM	SAP ITEM ID	PS ITEM ID
15kV	Effectively Grounded	95kV	C39B	9308832	5104316
23kV	Effectively Grounded	125kV	C39BA	9306763	9201943
23kV	Not Effectively Grounded	150kV	C39BB	9306764	9201942
35kV	Effectively Grounded	150kV	C39BC	9306762	9201944

NOTE: Item C39BB does not have a manual trip lever.

CAPACITOR – LINE POST CURRENT/VOLTAGE SENSORS

Capacitor line post current/voltage multicore sensors to be used with the advanced capacitor control (Std Item C39A1).

Insulator, Line post, current & voltage clamp top sensor, 35kV, Current signal output ratio: 600A:10V, Voltage signal output ratio: 2,000V:1V, BIL 200kV, Height: 20.8 IN, Weight: 59 pounds, Complete w/ 40 Ft. 4-position connectorized sensing cable.



Typical Jumper Installation

kV	WGT (lbs)	STD ITEM	SAP ITEM ID	PS ITEM ID
15	39	C39CS1	9307912	9202848
35	59	C39CS3	9307911	9202849

CABLE,

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Control 31’ cable, 8-pin, for switched bank	C39C	9391215	NA
Control 8’ cable, five pin connector on the switch end to interconnect a VSV to the junction box.	C39D	9311278	5104317
Control 35’, 5-pin female circular connectors from switch end to interconnect a VSV to the junction box. For use w/ STD Item C39A.	C39D1	9386556	9203023
Power 25’ cable, (2) live legs, (1) neutral, & (1) return leg 4-position female circular connector on 1 end & 4 tinned wires on other end	C39D2	9386557	9203024
Power cable (time clock style) 16’,2- #12, terminated on a 5 pin female conn.	C39D3	9391247	

BRACKET, METER SOCKET

1¼” X 7” (W X L), galvanized steel pole mounting, galvanized steel digital time clock capacitor control mounting, two required per installation.

STD ITEM	SAP ITEM ID	PS ITEM ID
C39E	9302932	5800702

SOCKET, CAPACITOR CONTROL

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
4 Position outdoor, 125 A rating.	C39F	9317380	5807703
6 position, includes pole-mounting bracket. 100A rating.	C39G	9306034[E]	5107061[E]

CAPACITOR – UNITS

Non-PCB, all-film dielectric, shunt-type, single or two bushing primary distribution capacitor units per MS2851. Does not include pole mounting hanger (STD ITEM C36A or C36B).

SIZE KVAR	NO. OF BUSHINGS	RATED BIL KV	RATED TERMINAL TO TERMINAL VOLTAGE	STD ITEM	SAP ITEM ID	PS ITEM ID
50	2	75	2400	C40AA	9300331	5350100
150	2	75	2400	C40AC	9300294[E]	5455015[E]
50	2	75	*4800	C40BA	9300329	5350300
100	2	75	*4800	C40BB	9300323	5376300
150	2	75	*4800	C40BC	9300401	5455215
200	2	75	*4800	C40BD	9301049	5455220
200	2	95	6640	C40CA	9300090	5455320
200	1	125	6640	C40CAA	9302088	5457320
200	2	95	7200	C40DA	9300493[E]	5455420[E]
300	2	95	7200	C40DB	9301060[E]	5455430[E]
50	2	95	7620	C40EA	9300328[Y]	5350500[Y]
100	2	95	7620	C40EB	9300322	5376500
200	2	95	7620	C40EC	9300091	5455520
300	2	95	7620	C40ED	9301061	5455530
200	2	95	7960	C40FA	9301063[E]	5455620[E]
300	2	95	7960	C40FB	9301087[E]	5455630[E]
200	2	95	13200	C40GA	9300313	5380700
300	2	95	13200	C40GB	9301086[E]	5455730[E]
200	2	95	13800	C40HA	9301229[E]	5455820[E]
200	1	125	13800	C40HAA	9302075	5457820
300	2	95	13800	C40HB	9301228[E]	5455830[E]
200	2	125	13200	C40KA	9300093	5457821
200	2	125	13800	C40LA	9300094	5457823
300	2	125	13800	C40LB	9300095	5457824
300	2	125	14400	C40MB	9300089	5457826
200	1	125	19920	C40NA	9301249	5458020
300	1	125	19920	C40NB	9301248	5458030

** WHEN USED ON 4160V CIRCUITS, REDUCE KVAR VALUES BY 25%*

CAPACITOR – PRE-ASSEMBLED THREE PHASE FIXED BANKS

Non-PCB, all-film dielectric, completely assembled and ready for installation fixed capacitor banks per MS2852.

BANK SIZE KVAR	SYSTEM VOLTAGE	INDIVIDUAL CAPACITOR UNITS			STD ITEM	SAP ITEM ID	PS ITEM ID
		SIZE	QUANTITY	N. OF BUSHINGS			
150	2400 delta	50	3	2	C40PFA	9301247	5458500
300		100	3	2	C40PFB	9300492	5459002
150	2400/4160 Grd Y	50	3	2	C40PFC	9301113	5458520
300		100	3	2	C40PFD	9301116	5459004
450		150	3	2	C40PFE	9301181	5459012
150	*4800 delta	50	3	2	C40PFEA	9386525	9203019
300		100	3	2	C40PFF	9301171	5459007
450		150	3	2	C40PFG	9301182	5459015
150	4800/8320 Grd Y	50	3	2	C40PFH	9301226	5458515
450		150	3	2	C40PFJ	9300911[E]	5459019[E]
600		200	3	2	C40PFK	9300910[E]	5459020[E]
600	7200/12470 Grd Y	200	3	2	C40PFL	9300921	5459040
900		300	3	2	C40PFM	9301053	5459140
600	7620/13200 Grd Y	200	3	2	C40PFQ	9300852	5459046
900		300	3	2	C40PFR	9300849	5459062
600	7960/13800 Grd Y	200	3	2	C40PFV	9300918[E]	5459042[E]
900		300	3	2	C40PFW	9300971[E]	5459068[E]

** WHEN USED ON 4160V CIRCUITS, REDUCE KVAR VALUES BY 25%*

CAPACITOR – PRE-ASSEMBLED THREE PHASE SWITCHED BANKS

Non-PCB, all-film dielectric, completely assembled and ready for installation switched capacitor banks per MS2852.

BANK SIZE KVAR	SYSTEM VOLTAGE	INDIVIDUAL CAPACITOR UNITS			STD ITEM	SAP ITEM ID	PS ITEM ID
		SIZE	QUANTITY	N. OF BUSHINGS			
150	2400 delta	50	3	2	C40PSA	9301252	5458505
300		100	3	2	C40PSB	9301128	5459005
150	2400/4160 Grd Y	50	3	2	C40PSC	9301236	5458517
300		100	3	2	C40PSD	9301169	5459006
450		150	3	2	C40PSE	9301180	5459011
150	*4800 delta	50	3	2	C40PSFEA	9308026	9202534
300		100	3	2	C40PSF	9301114	5459003
450		150	3	2	C40PSG	9300913	5459017
300	4800/8320 Grd Y	100	3	2	C40PSH	9301179[E]	5459009[E]
450		150	3	2	C40PSJ	9300912[E]	5459018[E]
600		200	3	2	C40PSK	9300922[E]	5459030[E]
600	7200/12470 Grd Y	200	3	2	C40PSL	9300850	5459060
900		300	3	2	C40PSM	9301037	5459067
1200		200	6	2	C40PSP	9301073	5459070
300	7620/13200 Grd Y	100	3	2	C40PSPA	9386501	9203005
600		200	3	2	C40PSQ	9300851	5459048
900		300	3	2	C40PSR	9300848	5459064
1200		200	6	2	C40PSS	9301059	5459072
1200	13280/23000 Grd Y	200	6	2	C40PST	9301056	5459076
600	7960/13800 Grd Y	200	3	2	C40PSV	9300888[E]	5459044[E]
900		300	3	2	C40PSW	9300847	5459066
1200		200	6	2	C40PSX	9301057[E]	5459074[E]
1200	19920/34500 Grd Y	200	6	1	C40PSY	9301055	5459100
1800		200	9	1	C40PSZ	9301054	5459110
1200	13,800 delta	200	6	2	C40PSXA	9388453	NA
1800	23,000 delta	300	6	2	C40PSZB	9390343[E]	NA
2700			9	2	C40PSZA	9300491[E]	5459500[E]

** WHEN USED ON 4160V CIRCUITS, REDUCE KVAR VALUES BY 25%*

CAPACITOR-PRE-ASSEMBLED THREE PHASE SWITCHED BANKS WITHOUT CONTROL WIRING

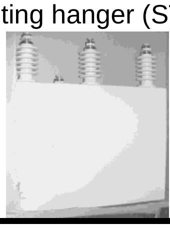
Non-PCB, all-film dielectric, completely assembled and ready for installation switched capacitor banks except without control wiring beyond the capacitor switches per MS2852. Use with Advanced Cap control C39A1.

BANK SIZE KVAR	SYSTEM VOLTAGE	INDIVIDUAL CAPACITOR UNITS			STD ITEM	MU NAME	SAP ITEM ID
		SIZE	QUANTITY	N. OF BUSHINGS			
150 300 450	2400/4160 Grd Y	50 100 150	3 3 3	2 2 2	C40SGC C40SGD C40SGE	@150KB416YSWADVANCED @300K3C2441YSWADVANCED @450KB416YSWADVANCED	9391305 9301616 9391284
600 900 1200	6640/11500 Grd Y	200 300 200	3 3 6	2 2 2	C40SGG C40SGH C40SGI	@600KB115YSWADVANCED @900KB115YSWADVANCED @1200KB115YSWADVANCED	9391317 9391327 9391326
300 600 900 1200	7200/12470 Grd Y	100 200 300 200	3 3 3 6	2 2 2 2	C40SGJ C40SGK C40SGL C40SGM	@300K3C1247KVSWADVANCED @600KB1247YSWADVANCED @900KB1247YSWADVANCED @1200KB1247YSWADVANCED	9393147 9391283 9391315 9391316
300 600 900 1200	7620/13200 Grd Y	100 200 300 200	3 3 3 6	2 2 2 2	C40SGP C40SGQ C40SGR C40SGW	@300K3C7613KVSWADVANCED @600KB7613YSWADVANCED @900KB7613YSWADVANCED @1200KB132YSWADVANCED	9390777 9301624 9301611 9391277
300 600 900 1200	7960/13800 Grd Y	100 200 300 200	3 3 3 6	2 2 2 2	C40SGS C40SGT C40SGU C40SGV	@300KB138YSWADVANCED @600KB138YSWADVANCED @900KB138YSWADVANCED @1200KB138YSWADVANCED	9386564 9386566 9386563 9386565
1200 1800	19920/34500 Grd Y	200 200	6 9	1 1	C40SGY C40SGZ	@1200KB35YSWADV-DIST @1800KB1934YSWADV-DIST	9391976 9392089
1200 ** 1800 **	19920/34500 Grd Y	200 200	6 9	1 1	C40TGY C40TGZ	@1200K3C1934YSWADVANCED @1800KB1934YSWADVANCED	9390859 9390906

** Note: Capacitors classified as transmission asset – NY.

CAPACITOR – THREE PHASE

Non-PCB, all-film, shunt-type, three bushing primary distribution capacitor per MS2851. Does not include pole mounting hanger (STD ITEM C36C or C36D).



KVAR SIZE	VOLTAGE	STD ITEM	SAP ITEM ID	PS ITEM ID
300	13,200V Grd Y / 7620V	C40P	9300311[Y]	5483570[Y]

CUTOUT, ENCLOSED PORCELAIN 5 kV FUSED AND DISCONNECTING

Grey porcelain housing, hook stick operable door with fuse tube or solid blade. Self-contained dropout operation. Fuse tubes accept standard K-link fuses (STD ITEM F1K) and includes NEMA standard crossarm mounting bracket. For MAINTENANCE ONLY

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
100A Small Box, Heavy Duty Dropout Fused	C41B1	9311902	2023930
100A Large Box, Extra Heavy Duty Indicating Fused	C41D1	9311766	2023562
200A Extra Large Box, Indicating Blade Disconnect	C41D2	9311901[Y]	2023939[Y]

CUTOUT, OPEN TYPE, 15KV STANDARD

Open type single stick operated fused cutout or disconnect for outdoor application on all overhead primary distribution circuits through 15 kV. Grey non-porcelain insulator, plated copper – eyelet connectors for #6 through 4/0 conductors, and galvanized load buster hooks PER MS2731.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
15 kV CUTOUT – 100A (Frame with 100A Fuse Holder)	C43S10	9309170	2023700
15 kV CUTOUT – 200A (Frame with 200A Fuse Holder)	C43S20	9314394	0811133
15 kV CUTOUT – 300A (Frame with 300A Solid Blade)	C43S30	9314395	0811134
100A FUSEHOLDER (For 10 – 100A Fuse links Only)	C43S11	9311747	2023701
200A FUSEHOLDER (For 140 & 200A Fuse links Only)	C43S21	9311746	2023702
300A SOLID BLADE (Non-Fused Disconnect)	C43S31	9311745	2023703

CUTOUT, OPEN TYPE, 27KV STANDARD

Open type single stick operated fused cutout or disconnect for outdoor application on all overhead primary distribution circuits through 35KV. Grey non-porcelain insulator, plated copper – eyelet connectors for #3 through 4/0 conductors, and galvanized load buster hooks per MS2740.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Complete assembly fused 100A w/o mounting bracket	C43S41	9317053	5901276
Fuse door only 100A	C43S51	9318884	5909441

POWER FUSE – (MOUNTING) SMD-20

SMD-20, 200 A maximum rating, outdoor dropout type, single polymer insulator style power fuse mounting, for use with SMU-20 fuses, (STD ITEM F6K for C47A and STD ITEM F8K for C48B). Mounting to include hanger for crossarm mounting, fuse end fittings, parallel-groove connectors and provisions for load busters. 20,000 A asymmetrical.

MAX. VOLTAGE	STD ITEM	SAP ITEM ID	PS ITEM ID
15 kV	C47A	9311769	2023522
27 kV	C47B	9317267	5909780

** For use where the available short circuit current exposure may be greater than 7,500 Amps symmetrical and where special coordination is required.*

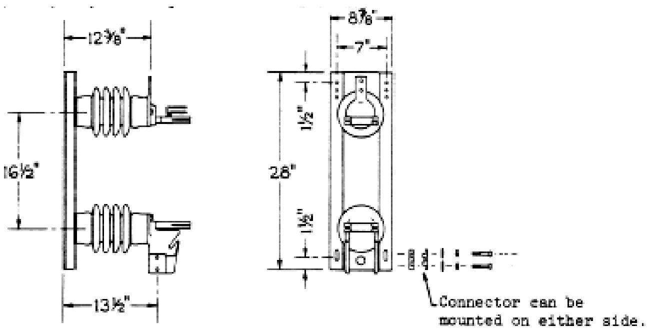
POWER FUSE – (MOUNTING) SMD-20, 34.5 kV

SMD-20, 200 A maximum rating, outdoor dropout type, single porcelain insulator style power fuse mounting, for use with SMU-20 fuses, (STD ITEM F9K). Mounting to include hanger for crossarm mounting, fuse end fittings, parallel-groove connectors and provisions for load busters. 20,000 A asymmetrical.

STD ITEM	SAP ITEM ID	PS ITEM ID
C48	9310261	9201149

POWER FUSE – (MOUNTING) SMD-5

S&C type SM-5, 14.4 kV, 400 A maximum rating, outdoor 180° opening, vertical style power fuse mounting with polymer station post insulators for use with S&C type SM-5 power fuse holder (C50B), and S&C type SM-5 fuses, (STD ITEM F5E). Each unit will be furnished with one parallel groove aluminum alloy bodied, tin-plated connector with galvanized steel bolts for a cable range of No. 2 solid through 500 KCMIL stranded copper or aluminum. No provision for load buster; non-load break type mounting. Heavy duty 40,000 asymmetrical at 14.4 kV.



STD ITEM	SAP ITEM ID	PS ITEM ID
C50A	9311793	2023520

POWER FUSE – (HOLDER) SMD-5

S&C type SM-5, 14.4 kV, 400 A maximum rating, outdoor power fuse holder for use with S&C type SM-5 power fuse mounting (STD ITEM C50A), and S&C type SM-5 fuses (STD ITEM F5E).

STD ITEM	SAP ITEM ID	PS ITEM ID
C50B	9311770	2023521

COVER, SNAP-ON TYPE, 600 VOLT MAXIMUM

One-piece black polyethylene snap-on insulating cover for compression-type (S13) or parallel groove bolted (C7B, C7D, C7E) service and secondary tap connectors.

	DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
	For compression connector, ⅝ or BG crimping die	C60B	9316075[Y]	2005601[Y]
	For compression connector, O crimping die	C60E	9316074	2005602
	For compression connector, D crimping die	C60G	9316073	2005603
	For compression connector, N crimping die	C60J	9316072	2005604
	For parallel groove one bolt connector (C7B). For temporary connections or in congested secondary/service cable installations.	C60R	9311084	9201346
	For parallel groove one bolt connector (C7D) or two bolt connector (C7E). For temporary connections or in congested secondary/service cable installations.	C60S	9311091	9201347

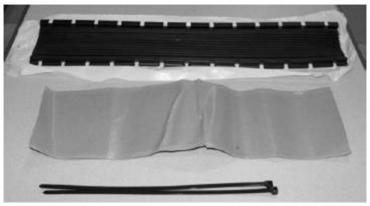
GEL FILLED ENCLOSURE COVER

Gel H-tap compression connector closure cover. Used for insulating and environmentally sealing up to 600 volt cable taps and splices made with H-tap compression connectors. Utilizes a sealing gel to protect connector from moisture ingress, corrosion, and pollution.
Use for coastal construction applications.

	DESCRIPTION	RUN CABLE	TAP CABLE	STD ITEM	SAP ITEM ID
	Small gel cover	1/0 – 4/0	#6 – 3/0	C61A	9387508
	Large gel cover	350	4/0	C61B	9387509

COVER – GELWRAP FOR TREE WIRE AND SPACER CABLE SPLICES

Gelwrap spacer cable/tree wire splice/skinning cover for 15 kV tree wire and spacer cable splices and skinnings.



DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
1/0 Al splices, 1/0 Al thru 556.4 kcmil Al skinnings	C62	9310416	9200661
336.4 kcmil Al thru 795 kcmil Al splices, 795 kcmil Al skinnings	C63	9306472	9200984

COVER – GELWRAP FOR TREE WIRE AND SPACER CABLE CONNECTOR TAPS

Gelwrap spacer cable/tree wire splice/skinning cover for 15 kV tree wire and spacer cable connector taps.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
1/0 Small Tap	C67	9306453	9201801
336.4 kcmil thru 477 kcmil splices, for large connectors	C68	9306452	9201802

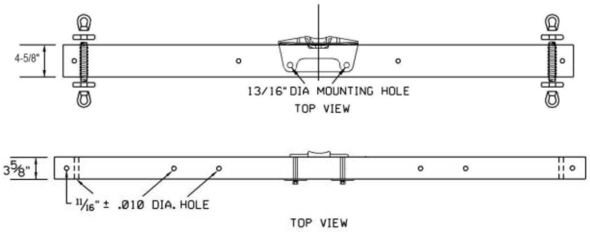
CLIP – FOR CONNECTOR TAPS

Clip, Gelwrap Cover for Spacer Cable/Tree Wire Connector Taps

STD ITEM	SAP ITEM ID	PS ITEM ID
C70	9308260	9201800

CROSSARM, FIBERGLASS

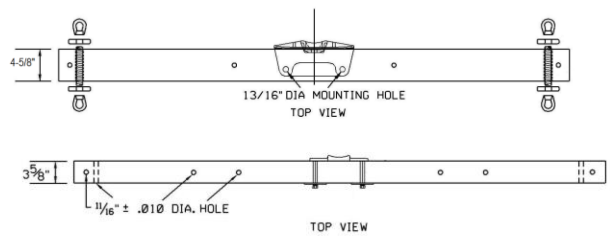
Heavy duty, 8-foot length, medium brown/bronze or light gray in color.



DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Deadend Arm	C76D	9306206	9201847
Tangent Arm	C76T	9306208	9201845

CROSSARM, FIBERGLASS

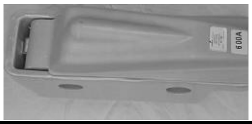
Heavy duty, 10-foot length, light gray in color.



DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Deadend Arm	C77D	9391756	N/A
Tangent Arm	C77T	9391755	N/A

SWITCH, DISCONNECT, 5 kV ENCLOSED

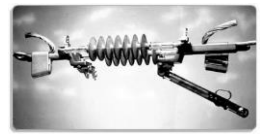
600A, polymer enclosed, single stick operated solid blade primary distribution switch; includes crossarm mounting bracket.



STD ITEM	SAP ITEM ID	PS ITEM ID
D1C	9311737	2027117

SWITCH, IN-LINE FIRED-ON WEDGE DISCONNECT

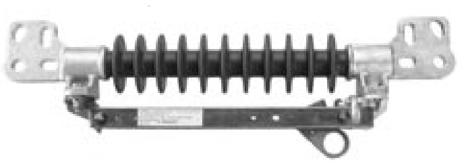
900A, fired-on wedge open-type, single stick operated primary distribution switch.



DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
15kV in-line disconnect and associated “C” members and wedges for use on 336 MCM AAC/ACSR conductors.	D3A	9307172	9200113
(1) replacement “C” member and wedge for use on 336MCM AAC / ACSR conductors.	D3AC	9307196[Y]	9200096[Y]
(1) replacement “C” member and wedge for use on 4/0 AAC / ACSR conductors.	D3AD	9307206	9200097
(1) replacement “C” member and wedge for use on 477 AAC conductors.	D3AE	9308310[E]	9201481[E]
(1) replacement “C” member and wedge for use on 1/0 AAC / ACSR conductors.	D3DA	9390123 [Y]	
15kV in-line disconnect and associated “C” members and wedges for use on 477 MCM AAC conductors.	D3B	9308445	9201483
35kV in-line disconnect and associated “C” members and wedges for use on 1/0 AAC conductors.	D3D	9390165 [Y]	-
35kV in-line disconnect and associated “C” members and wedges for use on 336.4, 350, 397.5 AAC conductors, 266.8, 336.4 ACSR conductors.	D3E	9390120 [Y]	-
35kV in-line disconnect and associated “C” members and wedges for use on 477 MCM AAC conductors.	D3C	9308309 [Y]	9201482

SWITCH, IN-LINE BOLTED DISCONNECT

35kV, 600A, 200 kV BIL bolted open-type, single stick operated in-line primary distribution switch with loadbuster hooks.

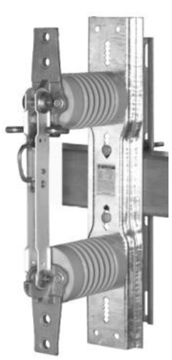


STD ITEM	SAP ITEM ID	PS ITEM ID
D4A	9306316	9201604

SWITCH, IN-LINE BOLTED WEDGE DISCONNECT
Switch, Inline Bolted Wedge, Single Phase, Single Stick Operated, 600amp rated, Loadbuster Provision, Includes Connectors, Per NEMA STDS/ ANSI C37.30
Note: some switches are rated for 900A, confirm manufacturer specification if higher amperage switch is needed.

VOLTAGE	WIRE RANGE	STD ITEM	SAP ITEM ID
15kV	MAX RANGE: .642 - .723 ACSR: 266.8 (26/7), 336.4 (18/1), (26/7) AAC: 336, 350, 397.5, 477 COMPACT 15 kV, 110 BIL	D4B	9391175
35kV	MAX RANGE: .642 - .723 ACSR: 266.8 (26/7), 336.4 (18/1), (26/7) AAC: 336, 350, 397.5, 477 COMPACT 35 kV, 200 BIL	D4C	9391169
15kV	MAX RANGE: .846 - .883 ACSR: 477 (24/7), (26/7), (30/7), 556.5 (18/1) AAC: 556 (19 STR, 37 STR) 15 kV, 110 BIL	D4D	9391168
35kV	MAX RANGE: .846 - .883 ACSR: 477 (24/7), (26/7), (30/7), 556.5 (18/1) AAC: 556 (19 STR, 37 STR) 35 kV, 200 BIL	D4E	9391170
15kV	MAX RANGE: .953 - 1.040 ACSR: 556 (24/7), (26/7), (30/7) 795 (36/1) AAC: 795 (37 STR, 61 STR) 15 kV, 110 BIL	D4F	9391241
35kV	MAX RANGE: .953 - 1.040 ACSR: 556 (24/7), (26/7), (30/7) 795 (36/1) AAC: 795 (37 STR, 61 STR) 15 kV, 200 BIL	D4G	9391240
ALL	Replacement Connector only for STD ITEM D4B, D4C	D4SCN	9391167
ALL	Replacement Connector only for STD ITEM D4D, D4E	D4LCN	9391216
ALL	Replacement Connector only for STD ITEM D4F, D4G	D4XCN	9391239

SWITCH, DISCONNECT, OPEN
Open-type, single stick operated, loadbuster disconnect switches per MS2761.



VOLTAGE	CURRENT (RATED)	STD ITEM	SAP ITEM ID	PS ITEM ID
15KV	600A	D5D	9311735	2027120
35KV	600A	D5F	9302650	5671712

SWITCH, LOADBREAK

Gang-operated side-break load break switch with grey polymer post insulators, fiberglass interface shaft, vertical operating rod (includes 7' FRP insulated section), lockable operator handle and NEMA two hole terminal pads. Switch shall comply with latest ANSI Std. C37.30 and MS2776 & MS2778. Note: See 22-TSXX section for Loadbreak switches for Sub Transmission.

VOLTAGE	CURRENT	STYLE	STD ITEM	SAP ITEM ID	PS ITEM ID
15KV	600A	Horizontal	D7D	9314777	0801619
15KV	600A	Vertical	D7E	9314407	0811143
15KV	900A	Horizontal (Hook-Stick)	D7L	9307838	9202746
15KV	900A	Vertical (Hook-Stick)	D7M	9390880	N/A
35KV	600A	Horizontal	D7F	9314410	0811140
35KV	1200A	Horizontal	D7G	9302569[E]	5670085[E]
35KV	600A	Vertical	D7H	9314409	0811141
35KV	600A	Phase-over-phase	D7J	9314408[Y]	0811142[Y]

SWITCH, LOADBREAK ACCESSORIES

Accessories for STD Item D7 loadbreak switches.

DESCRIPTION	APPLICATION	STD ITEM	SAP ITEM ID	PS ITEM ID
Shaft, tubular, fiberglass insulating section, 2-3/8" diameter	Used as a replacement part for the vertical section of the operating shaft for a D7D loadbreak.	D7DS	9386512	9203008
Conductor DE Links	For with deadending conductor on hook stick operable loadbreak switch 9202746	D7L1	9307954	9202819
Loadbreak Handle Extension Kit	Handle extension kit for use with 15kV loadbreak 0801619	D7M1	9307924	9202332
J Bolt, Extra Long, 20 ¼"	Extended length 20 ¼" J-Bolts - to be used with pole band on S&C Loadbreak switches when installing on larger diameter poles. All Loadbreak switches come with standard length J-bolts and pole bands. Use of the pole band with J-bolts is only necessary when dead-ending conductors on the sw.	D7JB	9391035	N/A

SWITCH, REGULATOR BYPASS

Pole mounted regulator bypass switch for energizing or bypassing single-phase pole mounted regulators per MS2780. Regulator shall be in manual, neutral, and off before switching.

STD ITEM	SAP ITEM ID	PS ITEM ID
D8	9320807	5670351

MOUNT, EQUIPMENT – 3Ø

48” three phase fiberglass equipment mount with aluminum or ferrous end fittings for mounting three cutouts and arresters to a wood pole. Approximately 26 lbs. and shall include (installed) (6) ½” X 2” captive carriage bolts, lock washers and hex nuts (galvanized or equivalent).

STD ITEM	SAP ITEM ID	PS ITEM ID
E12M	9311768	2023525

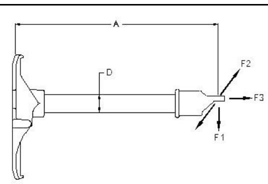
MOUNT, EQUIPMENT – 1Ø, 3-POSITION

18” single phase fiberglass equipment mount with aluminum or ferrous end fitting for mounting a cutout and arrester or a terminator and arrester to a wood pole. Approximately 5.3 lbs. and shall include (installed) (2) ½” X 2” captive carriage bolts, lock washers and hex nuts (galvanized or equivalent).

STD ITEM	SAP ITEM ID	PS ITEM ID
E13M	9308444	9201484

MOUNT, EQUIPMENT - 1Ø, 1-POSITION

18” single phase fiberglass equipment mount with a polymer protective coating. Includes 1 ½” carriage bolt, ½” hex nut, and ½” lock washer.



STD ITEM	SAP ITEM ID	PS ITEM ID
E13N	9308421	9202021

BRACKET, EQUIPMENT, SINGLE ARM

Aluminum, 34” long, for DA repeater radio and Omni antenna mounting. Includes 3/8” ground connector, two (2) ½” u-bolts, hat section, and pole mounting pattern to accommodate 8” spacing for 5/8” thru bolts.

STD ITEM	SAP ITEM ID	PS ITEM ID
E15B	9306267[Y]	9201877[Y]

FUSE, LINKS – 15KV TYPE "K"

Universal type 'K' expulsion fuse links per ANSI C37.42 shall have a normal length of 23" with a fuse tube length of 5" and have a removable button head. TCC No. 165-6.

FUSE TUBE RATING	FUSE RATINGS	STD ITEM	SAP ITEM ID	PS ITEM ID
100A	3A	F1K03	9314512	0811167
	6A	F1K06	9314511	0811168
	10A	F1K10	9316322	2009710
	15A	F1K15	9316320	2009715
	*20A	F1K20	9316319	2009720
	25A	F1K25	9316318	2009725
	*30A	F1K30	9316317	2009730
	40A	F1K40	9316316	2009740
	*50A	F1K50	9316315	2009750
	65A	F1K65	9316314	2009765
	*80A	F1K80	9316313	2009780
	100A	F1K100	9316312	2009781
200A	140A	F1K140	9316207	2009784
	200A	F1K200	9316206	2009792

* Identified as "non-preferred" sizes.
- Fuse 100A fuse holders with 3A thru 100A links only
- Fuse 200A fuse holders with 140A and 200A links only.
- 140A and 200A links shall have double pigtail.

FUSE, LINKS – 35KV TYPE "K"

Type 'K' expulsion fuse links per ANSI C37.42, shall have a normal length of 30" with a fuse tube length of 9" and have a non-removable buttonhead. TCC No. 165-6.

FUSE TUBE RATING	FUSE RATINGS	STD ITEM	SAP ITEM ID	PS ITEM ID
100A	3A	F1K03A	9316788E	5904004E
	6A	F1K06A	9316765	5904007
	10A	F1K10A	9310460E	5904011E
	15A	F1K15A	9316764E	5904016E
	25A	F1K25A	9316763E	5904026E
	40A	F1K40A	9316762E	5904041E
	*50A	F1K50A	9316761E	5904051E
	65A	F1K65A	9316760E	5904066E
	100A	F1K100A	9316759E	5904101E

* Identified as "non-preferred" sizes.
  - Fuse 100A fuse holders with 3A thru 100A links only

F USE, LINKS – 15KV TYPE "T"

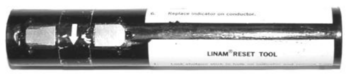
Type 'T' expulsion fuse links per ANSI C37.42, shall have a normal length of 23" with a fuse tube length of 5" and have a removable buttonhead. For use on the Brockton distribution system only. TCC No. 170-6.

FUSE TUBE RATING	FUSE RATINGS	STD ITEM	SAP ITEM ID	PS ITEM ID
100A	3A	F1T03	9302418E	5106493E
	*6A	F1T06	9302417E	5106494E
	10A	F1T10	9302387	5106495
	15A	F1T15	9302429	5106496
	25A	F1T25	9302386E	5106497E
	40A	F1T40	9302370E	5106498E
	65A	F1T65	9302353E	5106499E
	100A	F1T100	9302352E	5106500E
200A	140A	F1T140	9302351E	5106501E
	200A	F1T200	9302480E	5106502E

* Identified as "non-preferred" sizes.
  - Fuse 100 Amp fuse holders with 3 A thru 100 A links only
  - Fuse 200 Amp fuse holders with 140 A and 200 A links only.
  - 140A and 200A links shall have double pigtail.

TOOL, MANUAL RESET MAGNETIC

Manual reset magnetic tool for resetting fault indicators.



STD ITEM	SAP ITEM ID	PS ITEM ID
F2T	9314849	0802836

INDICATOR, FAULT CIRCUIT– LED – 5 TO 46 kV

Non-directional “Adaptive” style transient over current indicator for locating overhead primary circuit faults on radial circuits. 100A minimum trip accommodates all standard conductors and line loadings to 600A. Highly visible status lights include low-battery light. Hot stick application. Lithium battery for 900 hrs. of operation or 15 year shelf-life. Manual or automatic time-reset, flashing red LEDs reset upon restoration of (3A minimum) line current, yellow flashing LED’s remain on until automatic or manual reset.
Directional Fault indicators are to be used on “Network” non-radial circuits with multiple Fault Indicator site installations. The Source A and Source B must be determined.

AUTOMATIC TIME DELAY	CATALOG #	STD ITEM	SAP ITEM ID	PS ITEM ID
4 Hour Re-Set	41-2001-301	F3T4	9310705	0810608
8 Hour Re-Set	41-2001-302	F3T8	9314132	0810609
24 Hour Re-Set	41-2001-306	F3T24	9306812	9201665
4 Hour Re-Set	DIRECTIONAL	F3BI	9389245	

NOTE:
See STD ITEM F2T (ITEM ID 9314849) for Reset Tool

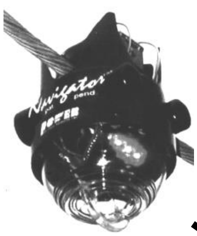
SMART INDICATOR, FAULT CIRCUIT– LED – 5 TO 69 kV

Non-directional (radial circuits) and Directional (“Network” non-radial circuits) “Smart” Fault Circuit Indicators (FCIs) detect fault events and will indicate locally via flashing LEDs and remotely via local RF connection to a collector box. Load Leveling and Load Memory features enable the FCI to automatically set fault trip levels in relation to peak and load current.

Note: The Source A and Source B must be determined for Directional FCIs and all units must be installed in a consistent manner with A pointing towards Source A and B towards Source B.

Smart FCIs communicate fault data, load current and status data.

EVENT BASED REPORTS	CONTINUOUS REPORTS
Fault Detection	Routine Call and Health Check
Momentary Versus Permanent	Battery Status
Fault Current Magnitude (RMS)	Average Load Current
Fault Duration (msec)	Peak Load Current
Last Known Load Current	Conductor Temperature
Time Stamp	Device Temperature
Fault Direction (if applicable)	



AUTOMATIC TIME DELAY	CATALOG #	STD ITEM	SAP ITEM ID	PS ITEM ID
24 Hr reset – Non-Directional	43-1118-206	F4T24	9393094	N/A
24 Hr reset – Directional	43-1518-206	F4T24D	9393255	N/A
Collector Box	DNP3-ST-NGRID	F4CB	9393370	N/A

NOTE:
See STD ITEM F2T (ITEM ID9314849) for Reset Tool

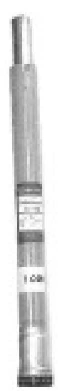
FUSE, POWER – SM – 5

S&C type SM-5, 14.4 kV power fuses for use with S&C type SM-5 power fuse holder, (STD ITEM C50B) and S&C type SM-5 power fuse mounting, (STD ITEM C50A). TCC No. 153-4.

FUSE RATING (AMPERES)	STD ITEM	SAP ITEM ID	PS ITEM ID
100E	F5E100	9313908	2018573
125E	F5E125	9312445	2018581
150E	F5E150	9313478	2018451
200E	F5E200	9313497	2018470
250E	F5E250	9312507	2018485
300E	F5E300	9312505	2018490
400E	F5E400	9319366	5908373

FUSE, 14.4kV POWER – SMU – 20

Power fuses for use with S&C type SMD-20 outdoor power fuse mounting (STD ITEM C47A). STD ITEM F6K to be ANSI "K" fast-speed T.C.C. No. 165-2. STD ITEM F6E to be ANSI "E" standard-speed TCC No. 153-1.



FUSE RATING (AMPERES)	STD ITEM	SAP ITEM ID	PS ITEM ID
20E	F6E020	9318875[E]	5908844[E]
30E	F6E030	9308177[E]	9201523[E]
50E	F6E050	9318874[E]	5908847[E]
65E	F6E065	9318873[E]	5908848[E]
80E	F6E080	9318872[E]	5908851[E]
100E	F6E100	9318888	5908866
125E	F6E125	9316329	2009125
150E	F6E150	9316328	2009150
175E	F6E175	9316327	2009175
200E	F6E200	9314995	2009201
10K	F6K10	9316297	2009010
15K	F6K15	9316296	2009015
25K	F6K25	9316295	2009025
30K	F6K30	9316294[Y]	2009030[Y]
40K	F6K40	9316293[Y]	2009040[Y]
50K	F6K50	9316292[Y]	2009050[Y]
65K	F6K65	9316291	2009065
80K	F6K80	9316308	2009080
100K	F6K100	9316310	2009100
140K	F6K140	9316311	2009140
200K	F6K200	9316326[Y]	2009200[Y]

ADAPTER, CURRENT – LIMITING FUSE TERMINAL

Tin plated copper alloy bar stock. Used for connecting a CLF directly to a hot line clamp for CSP transformer installations where sufficient operating space is questionable.

STD ITEM	SAP ITEM ID	PS ITEM ID
F7B	9311739[Y]	2023718[Y]

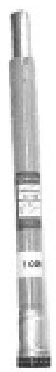
FUSE, PARTIAL RANGE CURRENT LIMITING (CLF)

Add-on partial range current limiting fuses for high fault current protection of overhead transformers and other distribution equipment. With eyebolt and universal adapter stud.

OPERATING VOLTAGE CLASS	CLF RATING	DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
15kV	8.3kV	25 A Coordinates with K link fuses up to and including 25 K.	F7A25	9312518	2018433
15kV	8.3kV	40 A Coordinates with K link fuses up to and including 40 K.	F7A40	9312514	2018445
15kV	8.3kV	65 A Coordinates with K link fuses up to and including 65 K.	F7A65	9307516	9202868
23kV	15.5kV	25 A Coordinates with K link fuses up to and including 25 K.	F7B25	9318221[E]	5907477[E]
23kV	15.5kV	40 A Coordinates with K link fuses up to and including 40 K.	F7B40	9319099[E]	5907481[E]
34.5kV	23kV	25 A Coordinates with K link fuses up to and including 25 K.	F7C25	9307566	9202957
34.5kV	23kV	40 A Coordinates with K link fuses up to and including 40 K.	F7C40	9307567	9202956

FUSE. 25kV POWER – SMU – 20

Power fuses for use with S&C type SMD-20 outdoor power fuse mounting (STD ITEM C47B). STD ITEM F8K to be ANSI “K” fast-speed T.C.C. No. 165-2. STD ITEM F8E to be ANSI “E” standard-speed T.C.C. No. 153-1.



FUSE RATING (AMPERES)	STD ITEM	SAP ITEM ID	PS ITEM ID
100E	F8E100	9318871[E]	5908864[E]
125E	F8E125	9318878[E]	5908865[E]
3K	F8K3	9309581[E]	5908860[E]
10K	F8K10	9318907[E]	5908872[E]
15K	F8K15	9318955[E]	5908876[E]
25K	F8K25	9318954[E]	5908877[E]
40K	F8K40	9321503[E]	5908878[E]
65K	F8K65	9318971[E]	5908879[E]
80K	F8K80	9309580[E]	5908863[E]
100K	F8K100	9318958[E]	5908873[E]
140K	F8K140	9318988[E]	5908892[E]

FUSE. 34.5Kv POWER – SMU-20

Power fuses for use with S&C type SMD-20 outdoor power fuse mounting (STD ITEM C48), ANSI “K” fast-speed T.C.C. No. 165-2.

FUSE RATING (AMPERES)	STD ITEM	SAP ITEM ID	PS ITEM ID
3K	F9K3	9310318[Y]	9201150[Y]
20K	F9K20	9311581	2018794
30K	F9K30	9307549	9202877 [Y]
40K	F9K40	9312447	2018828
50K	F9K50	9311657[Y]	2018836[Y]
65K	F9K65	9311546	2018847

FUSE, CURRENT – LIMITING 15A, 600V

Dual element fast acting 600V, 15A RK5 Class. With an interrupting rating of 200,000A rms

STD ITEM	SAP ITEM ID	PS ITEM ID
F10A15	9321458	8026195

HOLDER, FUSE 600V, 30A

30A 600V In line molded plastic, watertight, disconectable fuse holder, with crimp type terminals. Fits copper cable size #14 thru #8awg.

STD ITEM	SAP ITEM ID	PS ITEM ID
F50BA	9321403	8026185

CLAMP, GROUND ROD

High strength corrosion resistant copper alloy ground rod clamp with a square or hex head bolt. Clamp shall accommodate #8 solid - 1/0 stranded. Copper conductor on a ⅝" diameter ground rod. Connector shall be permanently stamped / marked "Direct Burial" and "UL".

GROUND ROD DIAMETER	STD ITEM	SAP ITEM ID	PS ITEM ID
5/8"	G2A2	9313446	3503328
¾"	G2A3	9388145	-----------

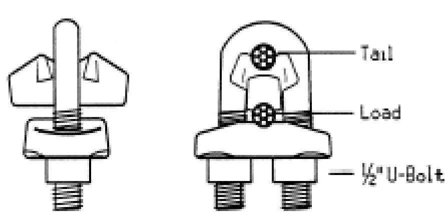
CLAMP, GROUND ROD

High strength corrosion resistant copper alloy ground rod clamp with silicone bronze hardware. Clamp shall accommodate a range of solid to stranded copper conductor parallel, or at right angles to a ⅝" diameter ground rod.

STD ITEM	AWG				SAP ITEM ID	PS ITEM ID
	MIN		MAX			
	SIZE	DIA, IN	SIZE	DIA, IN		
G4	2/0 Solid	0.365	250 KCMIL	0.575	9313417	3503390
G5	4 Solid	0.204	2/0 STR	0.419	9305898	5106194

CLAMP, GUY, U-BOLT TYPE

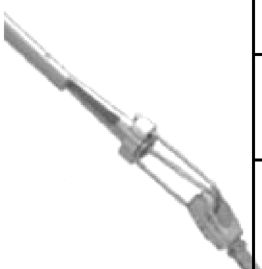
With separating block; hot dip galvanized.



STD ITEM	SAP ITEM ID	PS ITEM ID
G5B	9313415[Y]	3503396[Y]

GRIP, GUY, AUTOMATIC

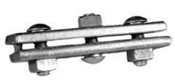
Strandvise with stainless steel anchor eye bail. Use long bail grips for clearance next to standard length bails.



GUY SIZE	A	B	STD ITEM	SAP ITEM ID	PS ITEM ID
6M (5⁄16”)	10”± 13 57⁄64”	4¾”± 8 57⁄64”	G5C2 G5C1	9313524 9313499	3503515 3503526
10M,12.5M (⅜”)	8”± 18”	5”± 11½”	G5C4 G5C4L	9313523 9313498	3503516 3503527
16M (7⁄16”)	14½” 19¼”	4½ - 7½” 12⅛”	G5C6 G5C6L	9313501 9313476[Y]	3503517 3503528[Y]

CLAMP, GUY, BOLTED

Parallel groove dead-end clamp for guy strands, hot dipped galvanized steel construction. NEMA Standard PH-24, 1964.



LENGTH	BOLTS	STRAND RANGE	STD ITEM	SAP ITEM ID	PS ITEM ID
3⅜”	2 x ½”	¼” - ⅜”	G7A	9314919[Y]	3503392[Y]
6”	3 x ⅝”	5⁄16” – ½”	G7B	9313416	3503393

GREASE, INHIBITING

Oxide inhibiting and sealing compound grease for all aluminum-to-aluminum or aluminum-to-copper electrical connections. Synthetic, non-petroleum base with conductive grit. Not for use on fastener threads. Furnished in 8 oz. plastic squeeze bottle.

STD ITEM	SAP ITEM ID	PS ITEM ID
G9B	9321951	8010034

WIRE, GUY

Bare 7 strand guy strain wire. Steel wire shall be B coat galvanized, electroplated or hot dip galvanized per ASTM A475 or A363 or aluminized per ASTM A474. Copperweld (CW) shall be in accordance with ASM A460. 250' coil, for reel quantities see TG51 shield wire.

TYPE	DIA.	RATED BREAKING STRENGTH	WEIGHT LBS./FT.	STD ITEM	SAP ITEM ID	PS ITEM ID
12.5M Alumo-weld 7/#9 AWG	⅜" (7 X 0.114")	12630 lbs.	0.208	G15A	9314658	0811118
16M Utilities Grade AZ or GB-Galv. Steel	7⁄16" (7 X 0.145")	18000 lbs.	0.399	G17A	9315838[Y]	4040027[Y]
16M EHS Grade Copper-weld Steel	7⁄16" (7 X #7AWG)	16890 lbs.	0.4084	G17B	9315841	4040009
	NOTE: This item is used for SubTransmission guying applications and messenger wire in Distribution applications (not used for guy wire in Distribution applications).					

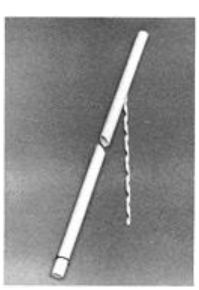
THIMBLE, GUY

Guy Wire Thimbles for strand size 1/2" . Open end slips over ovaleye anchor rods and bolts. Grooved to fit various strand sizes, they are made from crescent-shaped stock to prevent abrupt, strand-weakening kinks. Hot dip galvanized steel.

STD ITEM	SAP ITEM ID	PS ITEM ID
G19	9313880[Y]	3503702[Y]

GUARD, GUY WIRE MARKER – YELLOW

Full round 1¼" – 1½" diameter X 8' long UV resistant HDPE snap-on with nylon attachment pigtail or bolted clamp. Standard package contains 9 pieces.



STD ITEM	SAP ITEM ID	PS ITEM ID
G21E	9313584	3503077

HOOK, GUY

Galvanized cast iron for all down guys. Attach guy wire (STD ITEM G11 through G18) to wood pole. NEMA Standard PH11-1979.



DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Single Bolt Type For use with one ⅝" (B13) or ¾" (B14) bolt.	G33A	9313583	3503097
Two Bolt Type For use with two ¾" (B14) bolts.	G33B	9309164	3503098
Galvanized malleable iron with fiber rod attachment. ¾" hole, for use with ⅝" or ¾" bolt.	G33C	9313320	5988602

FITTING, BASE, SIDEWALK GUY

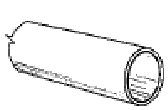
Hot dip galvanized malleable iron fittings for special light duty strut guying applications. To be used with sidewalk strut G36 galvanized steel pipe.



DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Pole base collar with square head set screw. Flange attaches to pole with two ½" lags and one ⅝" thru bolt. For 2" pipe.	G35A	9314246	0809971
Single wire end fitting clamp with square head set screw for 2" pipes.	G35B	9314245	0809972
Double wire end fitting clamp with square head set screw for 2" pipes. To be used with bolted guy clamp (G7B) when two guy strands are used.	G35C	9311085	9201345

CONDUIT, GALVANIZED - SIDEWALK STRUT

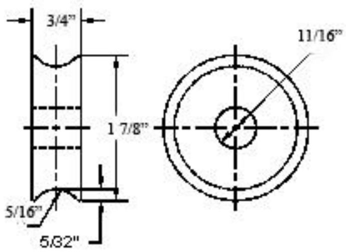
Hot dip galvanized steel pipe for special light duty strut guying applications. To be used with sidewalk strut guy fittings G35.



DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
2" X 7' Galvanized steel pipe.	G36	9307182	5993876

ROLLER, GUY

21,000 lb. maximum rating.



STD ITEM	SAP ITEM ID	PS ITEM ID
G50	9308136	9201776

ARRESTER, ISOLATING GAP, 11kV

For use as an isolating gap for capacitor banks on 4.8kV Delta systems. This arrester is connected between the equipment/arrester ground conductors and the secondary/neutral conductor.

STD ITEM	SAP ITEM ID	PS ITEM ID
L2	9313838	5980645

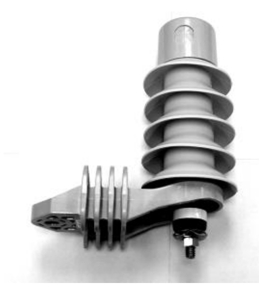
ARRESTER, SURGE – LINE TYPE

Distribution class line type, polymer housed MOV surge arresters used to protect overhead equipment and circuits. Shall comply with latest revision of ANSI C62.11 and MS 2608. Includes insulating top cap and black bottom isolator.

RATING	MCOV	CREEP	STD ITEM	SAP ITEM ID	PS ITEM ID
3 kV	2.55 kV	Standard	L3A	9316340	2006040
10 kV	8.40 kV	Standard	L3D	9314979	2006042
12 kV	10.2 kV	Standard	L3E	9316339	2006043
15 kV	12.7 kV	Standard	L3F	9316338	2006044
21 kV	17.0 kV	Standard	L3G	9308924[E]	5100678[E]
27 kV	22.0 kV	Standard	L3J	9316336	2006053

ARRESTER, SURGE – RISER TYPE

Distribution class riser type, polymer housed MOV surge arresters used to protect underground equipment and circuits at riser poles. Shall comply with latest revision of ANSI C62.11 and MS 2608. Includes insulating top cap and yellow bottom isolator.



RATING	MCOV	CREEP	STD ITEM	SAP ITEM ID	PS ITEM ID
10 kV	8.40 kV	Standard	L3DR	9308923	5100681
12 kV	10.2 kV	Standard	L3ER	9308922	5100682
12 KV (added creep)	10.2 kV	21" min.	L3ERN	9306415	9200974
15 kV	12.7 kV	Standard	L3FR	9308921	5100683
21 kV	17.0 kV	Standard	L3GR	9308920[E]	5100684[E]
27 kV	22.0 kV	Standard	L3JR	9308919	5100685

ISOLATOR, SPECIAL NEUTRAL

Stray voltage blocker for special use only, to isolate customer neutral from the common neutral. Includes pole mounting bracket. Refer to EOP G003, G004, G040 for procedures.

MAX. VOLTAGE THRESHOLD	STD ITEM	SAP ITEM ID	PS ITEM ID
22 Volts	L4A	9315127	0810202
45 Volts	L4B	9315126	0810203

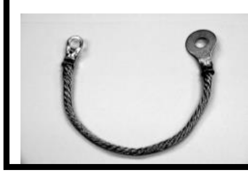
LEAD, FLEXIBLE LINE ARRESTER GROUNDING

Bare rope lay, stranded, tinned, copper conductor. 7 X 85 strands of #32 wire, with a ⅜" hole tinned copper ring terminal at one end and ½" min. to 1" maximum length, solder dipped or ferrule crimped (⅜" min. 0.D.) on the other.

LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
12 inches	L6	9316058	2006158
24 inches	L6L	9306499	9201962

LEAD, FLEXIBLE XFMR ARRESTER GROUNDING

12" Long bare rope lay, stranded, tinned, copper conductor. 7 X 85 strands of #32 wire, with a ⅜" hole tinned copper ring terminal at one end and a ½" hole tin copper ring terminal at the other end. For grounding transformer mounted arresters.



STD ITEM	SAP ITEM ID	PS ITEM ID
L6B	9306922	9200395

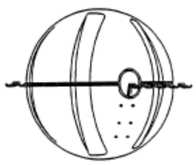
LOCKNUTS

Galvanized steel palnut or MF type.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
⅜"	L10A	9322019	7024164
½"	L10B	9322020	7024159
⅝"	L10C	9322021	7024158
¾"	L10D	9322023	7024155
⅞"	L10E	9322022	7024156

MARKER, AERIAL LINE

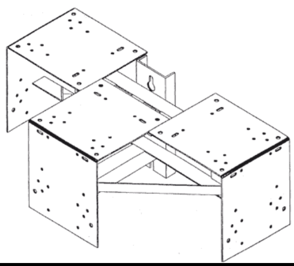
Plastic, International Orange, 20-inch diameter, includes preformed attachment wires and mounting hardware, FAA approved. Contact Distribution Engineering Services if installation guidelines are needed.



WIRE SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
#2 Bare ACSR	L20B	9319521	8002249
1/0 ACSR	L20C	9319519	8002251
336.4 Bare Al	L20E	9319518	8002252
7/16" Shield Wire	L20F	9319946	8002286

HANGER, METERING

All aluminum construction for mounting current and voltage transformers for primary metering installations. Channel is pre-punched for 5/8" thru-bolts (bolts not provided) or stainless steel banding may be used.



	STD ITEM	SAP ITEM ID	PS ITEM ID
3 position	M36C	9302952	5806744
2 position	M36C1	9302953	5806742

METER BRACKET

Bracket, Pole Mounting, 12 IN X 1.25 IN, Welded Steel with 2.75 IN slots, 8.75 IN on-center OR 11.5IN X 1.5IN X 3/16IN thick Aluminum with 7/16IN pole mounting slots. Used to mount single Class 20 meter socket to pole. (2 REQD PER INSTALLATION).

STD ITEM	SAP ITEM ID	PS ITEM ID
M36D	9306078	

PRIMARY METERING - SECONDARY CONDUIT KIT

All necessary items to build an OH Primary metering secondary conduit system including 1" Flex conduit (precut 25'), all fittings, clips, animal guards and misc. hardware. Does not include 1" PVC Conduit.

STD ITEM	SAP ITEM ID	PS ITEM ID
M37	9388574	

CLAMP, LASHING

0.500” – 0.245”, Tin plated bronze to be used to connect aluminum lashing wire to a 1/0 – ¾ AWAC messenger.

STD ITEM	SAP ITEM ID	PS ITEM ID
NC8E	9307355[E]	5985410[E]

CLAMP, SINGLE TONGUE

Adjustable clevis, bolted jumper, 795 KCM ACSR, 54/7, aluminum DE comp condor.

SIZE	MATERIAL	STD ITEM	SAP ITEM ID	PS ITEM ID
795 KCM ACSR, 54/7,	Alum. DE comp condor	NC13A	9310703	5986321
900 KCM, AA 37/0	Alum. DE comp cockscomb	NC13B	9320185[E]	5986322[E]
1113 KCM 54/19 strand ACSR	Alum. DE comp finch	NC13C	9307457	5986332

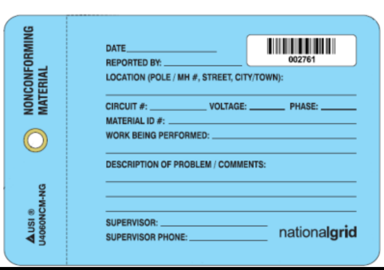
CLIP, BONDING

Steel construction.

SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
1” WD X 1½” LG For use with a 5/8” bolt	NC22	9320450	5987955
For use with a ¾” bolt	NC23	9313173	5987950

TAG, NONCONFORMING

Used for tagging nonconforming electric material and reporting issues to Electric Material Standards.



STD ITEM	SAP ITEM ID	PS ITEM ID
NCM1	9390572	N/A

COMPOUND, ELECTRICAL JOINT

8 oz. tube for use on aluminum-to-aluminum and aluminum-to-copper connections using weather exposed parallel groove clamp and compression connections on bare or covered line wire.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
For weather exposed parallel groove clamp and compression connections on bare or covered line wire.	NG9C		5591770[E]
For flat-to-flat surface such as bus-to-bus, terminal pad-to-dead-end, and terminal pad-to-bus.	NG9D	9303776	5591772

LINK, EXTENSION BAR

14” long, 15,000 lbs. rating deadend bar used in two pole customer substation primary switch installations.

STD ITEM	SAP ITEM ID	PS ITEM ID
NL2	9306975	5980862

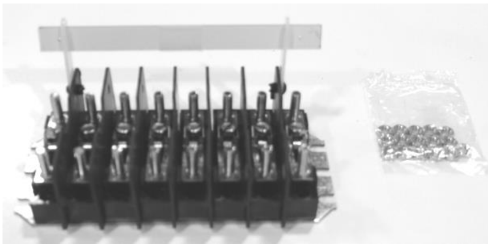
PLATE, EXTENSION

2½” wide X 24” long X ⅜” thick, galvanized steel construction.

STD ITEM	SAP ITEM ID	PS ITEM ID
NL3	9320541[E]	5980870[E]

BLOCK, TERMINAL

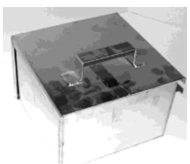
600 V, 60 A, screw wire terminal, 3” WD X 5¾” LG X 1½” HT, 8 pole N-T sliding link type circuit



STD ITEM	SAP ITEM ID	PS ITEM ID
NS4	9303001[E]	5690805[E]

CABINET, JUNCTION BOX

9” SQ. X 6” HT aluminum construction.



STD ITEM	SAP ITEM ID	PS ITEM ID
NS6	9317468[E]	5801060[E]

TUBING, HEAT SHRINK

Heat shrink tubing with inside diameter of minimum ID.

MIN. INSIDE DIAMETER	STD ITEM	SAP ITEM ID	PS ITEM ID
0.59”	NT1	9310900[E]	5100584[E]
1.18”	NT2	9310898[E]	5100585[E]
1.97”	NT3	9310897[E]	5100586[E]

BRUSH, WIRE

10” large wire type brush, 3½” conductor trim length, and plastic handle.

STD ITEM	SAP ITEM ID	PS ITEM ID
NTE1	9318423	5463900

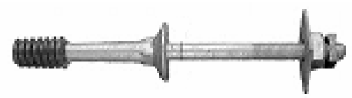
WASHER, FRAMING

Galvanized malleable iron, round, black, unthreaded.

NOM. SIZE	ID	OD	THK.	STD ITEM	SAP ITEM ID	PS ITEM ID
1”	1¹⁄₁₆"	5”	1”	NW4B	9306403	5997550
1 ¼”	1⁵⁄₁₆"	6”	1”	NW4C	9319597	5997570

PIN, INSULATOR

For installation of 15kV standard top groove pin insulator (STD ITEM I6) on standard 4½" wood cross arm (C31). Galvanized steel with standard 1" nylon top thread. Includes 2" square washer, square nut and locknut. ANSI C135.17 Item No. 3.



LENGTH	DIAMETER	STD ITEM	SAP ITEM ID	PS ITEM ID
10¾"	⅝"	P1A	9312032	3502434

PIN, INSULATOR

For installation of 35kV standard top groove pin insulators (STD ITEM I6) or when using the heavy duty crossarm (TC10). Galvanized steel with standard 1" nylon top thread. Includes square washer, square nut and locknut.

LENGTH	DIAMETER	STD ITEM	SAP ITEM ID	PS ITEM ID
13½ "	¾"	P1A2	9307183	5993765

PIN, INSULATOR

For installation of standard top groove pin insulator (STD ITEM I6P) on standard Hendrix 15kV C and E brackets. Galvanized steel short shank with standard 1" nylon thread. Includes split washer and square nut.

LENGTH	DIAMETER	STD ITEM	SAP ITEM ID	PS ITEM ID
8"	¾"	P1C1	9319930	5993670

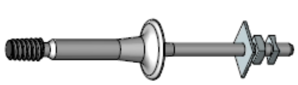
PIN, INSULATOR

For installation of standard top groove pin insulator (STD ITEM I6P) on standard Hendrix 35kV C braced bracket. Galvanized steel short shank with standard 1" nylon thread. Includes split washer and square nut.

LENGTH	DIAMETER	STD ITEM	SAP ITEM ID	PS ITEM ID
9½"	¾"	P1C2	9307168	5993671

PIN, INSULATOR

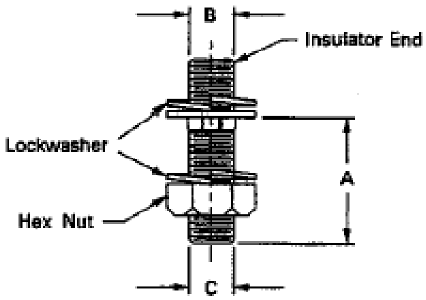
For installation of 35kV HPDE top groove pin insulator (STD ITEM I6PA) on wood crossarms. Above arm length 7-7/8". Galvanized steel standard 1" nylon thread. Includes split washer and square nut.



LENGTH	DIAMETER	STD ITEM	SAP ITEM ID	PS ITEM ID
15-3/8"	5/8"	P1C3	9391217	N/A

STUD, DOUBLE ENDED

Studs are ¾" diameter where they thread into the base casting of a post insulator. Two lock washers and hex nut are included.



DIMENSIONS			STD ITEM	SAP ITEM ID	PS ITEM ID
A	B	C			
1¾"	¾"	⅝"	P1D	9319590	5996700
7½"	¾"	⅝"	P1E	9310700[E]	5996705[E]
1¾"	¾"	¾"	P1F	9311934	2021361
2-3/4"	¾"		P1F1	9307548	9202878
7.0"	¾"	¾"	P1G	9311933	2021362

Note: To go through sleeve provided for horizontal mounting of post-type insulator on steel pole.

PLATE, CROSSARM REINFORCING & PIN HOLE ADAPTER

For use when retrofitting older distribution crossarms from wood insulator pins to ⅝" steel pins for 15 kV operation. 7 ga. (0.144") - ⅛" (0.125") thick, galvanized steel with ¾" to 13/16" pin-hole.

STD ITEM	SAP ITEM ID	PS ITEM ID
P2S	9312037	3502284

PIN, INSULATOR

For use with top groove insulator (STD ITEM. I6). Galvanized steel with No. 22 X 2¼" wood screw and 1" lead or nylon thread per ANSI C135.17.

STD ITEM	SAP ITEM ID	PS ITEM ID
P3	9311949	3502148

PIN, POLE TOP – EPOXY

EPDM or silicon rubber coated epoxirod or equivalent with plastic coated 1" standard threaded aluminum ferrule and ferrous or aluminum base with 11/16" mounting holes. For primary distribution – armless construction.

CANTILEVER STRENGTH	LENGTH	DIAMETER	STD ITEM	SAP ITEM ID	PS ITEM ID
1400 lb.	24"	1.5"	P6B	9313617	3502922

PIN, POLE TOP – STEEL

Galvanized steel with ANSI C135.17 1" standard lead or nylon pin thread. One $\frac{11}{16}$" mounting hole and one $\frac{11}{16}$" X 1¼" slot. Per latest ANSI Std. C135.22. 10,000 specified mechanical load (SML).

STD ITEM	SAP ITEM ID	PS ITEM ID
P7A	9311728	3502834

PIN, ANGLE

Malleable iron or steel, galvanized with 1" lead thread or nylon alloy. For side pole or crossarm mounting. Used with ⅝" bolt.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
15KV	P8	9311837	3502838
35KV	P8A	9308311	9201480

CAP, WOOD POLE TOP PROTECTION

Polyethylene 9-1/2" cap for overhead distribution.

STD ITEM	SAP ITEM ID	PS ITEM ID
P9	9303047	5466570

CAP, WOOD POLE TOP PROTECTION, 16"

Butyl mastic rubber pole topper for overhead distribution.

STD ITEM	SAP ITEM ID	PS ITEM ID
P9A	9307970	9202222

PIN, 24" EPOXY STANDOFF

EPDM or silicon rubber coated epoxirod or equivalent with plastic coated 1" standard threaded ferrule and ferrous or aluminum base with $\frac{11}{16}$" mounting holes. For side pole mounting – Armless construction. 0° - 20° line angles.

STD ITEM	SAP ITEM ID	PS ITEM ID
P10B	9314066	0810367

POLES, WOOD

Full length penta-treated Southern Yellow Pine per MS2005 and latest ANSI Std. 05.1.

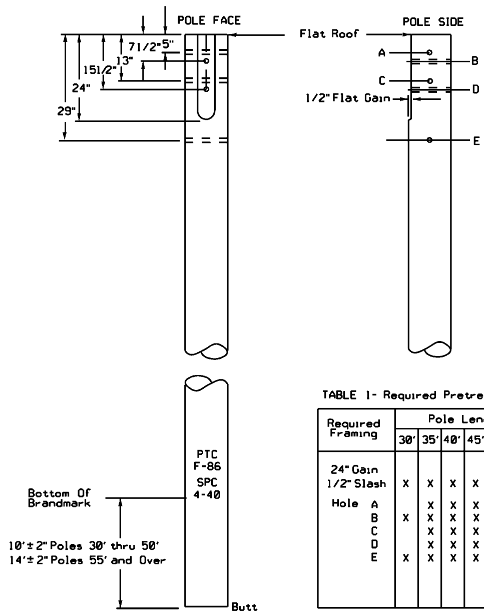


TABLE 1- Required Pretreatment Framing

Required Framing		Pole Length -- Feet					
		30'	35'	40'	45'	50'	50' & Over
24" Gain 1/2" Slash		X	X	X	X	X	X
Hole	A		X	X	X	X	X
	B	X	X	X	X	X	X
	C		X	X	X	X	X
	D		X	X	X	X	X
	E	X	X	X	X	X	X

LENGTH /CLASS	STD ITEM	SAP ITEM ID	PS ITEM ID
35'-1	P11A1	9302893	5970351
35'-2	P11A2	9311618	3501352
35'-3	P11A3	9311617	3501353
35'-4	P11A4	9302892	5970354
35'-5	P11A5	9311616	3501355
40'-H1	P11BH1	9388196	9388196
40'-1	P11B1	9302891	5970401
40'-2	P11B2	9311615	3501402
40'-3	P11B3	9311614	3501403
40'-4	P11B4	9311613	3501404
45'-H1	P11CH1	9388197	9388197
45'-1	P11C1	9311612	3501451
45'-2	P11C2	9311611	3501452
45'-3	P11C3	9311610	3501453
50'-H1	P11DH1	9388195	9388195
50'-1	P11D1	9311609	3501501
50'-2	P11D2	9311587	3501502
50'-3	P11D3	9311586	3501503
55'-1	P11E1	9311584	3501551
55'-2	P11E2	9311691	3501552
55'-3	P11E3	9309166	3501553
60'-1	P11F1	9311708	3501601
60'-2	P11F2	9311707	3501602
60'-3	P11F3	9311706	3501603
65'-1	P11G1	9311703	3501651
65'-2	P11G2	9312398	3501652
65'-3	P11G3	9312530	3501653
70'-1	P11J1	9311699	3501701
70'-2	P11J2	9311698	3501702
70'-3	P11J3	9311697	3501703

BRAND LOCATION

POLE LENGTH (feet)	GROUNDLINE DISTANCE FROM BUTT (feet)	BRAND LOCATION FROM BUTT (feet)	POLE LENGTH (feet)	GROUNDLINE DISTANCE FROM BUTT (feet)	BRAND LOCATION FROM BUTT (feet)
30	5	11	55	7.5	13.5
35	5.5	11.5	60	8	14
40	6	12	65	8.5	14.5
45	6.5	12.5	70	9	15
50	7	13			

EXTENSION, POLE TOP – 5’

Wood OR fiberglass pole top extender with galvanized steel connector bracket for 6” to 12” diameter pole tops.

TYPE	STD ITEM	SAP ITEM ID	PS ITEM ID
Fiberglass	P12A1	9308035	9202185
Wood	P12A	9311701	3502054

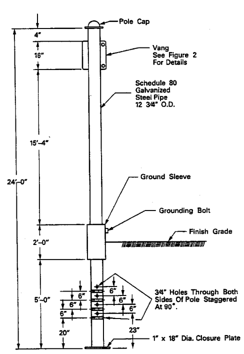
BRACKET, POLE TOP

Galvanized steel construction pole top brackets. P12B-is used to mount line post insulators and provide increased distance in separation of the middle phase. P12C-is a pole top extension used with spacer cable configurations.

LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
14”	P12B	9307367	5984620
60”	P12C	9320106	5984556

POLE, STEEL STUB

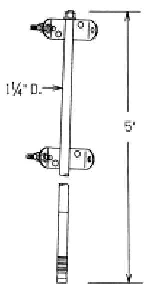
Steel guy stub pole for use in difficult guying situations. Tubular steel shaft includes pole cap, guy wire attachment vang, grounding nut and ground sleeve per MS2355.



LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
24’	P13	9306961	5973014

ANCHOR, ROCK, POLE LEG (ONE)

Galvanized steel rock anchor leg assembly. For mounting wood poles on solid rock. Complete with all hardware and pole identification tag. Requires 2" X 24" drilled hole for each leg installation.



FOR POLE BUTT DIAMETERS	QUANTITY REQ'D. PER INSTALLATION	STD ITEM	SAP ITEM ID	PS ITEM ID
8" – 12" 11" – 16" 14" – 20"	3 4 5	P14A	9313581	3503112
REUSABLE HOLE-DRILLING TEMPLATES				
3 – Hole Template		P14AT	9313559	3503114
4 – Hole Template		P14BT	9313706	3503118
5 – Hole Template		P14CT	9313705	3503119

BRACKET, ANGLE SWINGING

15" projection, 9" bolt spacing, 20 M rating @ 45° including ¾" X 14" mounting bolts for distribution supply installations.

STD ITEM	SAP ITEM ID	PS ITEM ID
P15	9310816	5105647

ATTACHMENT, PUSH BRACE

Galvanized malleable iron connector for attachment of push brace to wood poles at 0° - 90°. Requires (4) ¾" bolts.

STD ITEM	SAP ITEM ID	PS ITEM ID
P16	9311702	3502040

BRACKET, E – 15kV SPACER CABLE

Galvanized E bracket including ⅝" diameter U bolt. For light and heavy angle poles not exceeding 60°. Insulator pins (STD Item P1C1) come separately.

HEIGHT	WIDTH	CHANNEL	STD ITEM	SAP ITEM ID	PS ITEM ID
35"	11 1/2"	3"	P17A	9320105	5984596

BRACKET, C – 15kV SPACER CABLE

Galvanized C bracket with 8" mounting hole spacing. For heavy angle poles not exceeding 90°. Insulator pins (STD Item P1C1) & double insulator plates (STD Item I20B) come separately.

HEIGHT	WIDTH	CHANNEL	STD ITEM	SAP ITEM ID	PS ITEM ID
16 1/2"	11 1/2"	3"	P17B	9320104	5984600

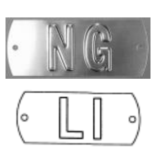
BRACKET, C – 35kV SPACER CABLE

Galvanized C bracket with 8" mounting hole spacing. Includes welded gussets for maximum strength. For light and heavy angle poles not exceeding 90°. Insulator pins (STD Item P1C2) come separately.

HEIGHT	WIDTH	CHANNEL	STD ITEM	SAP ITEM ID	PS ITEM ID
16 1/2"	13 1/2"	3"	P17C	9320103[E]	5984603[E]

TAG, NAME

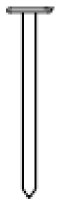
For wood pole identification purposes. Aluminum embossed with ⅞" bold modern Roman letters. Two 1⁄10" - 3⁄32" mounting holes.



DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
PPL Pole Tag	P20A	9311951	3502140
Pole Line Number Tag	P20B	9319993[Y]	8002361[Y]

NAIL, TAG

Common flat head nails.



USAGE	SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
Aluminum – For wood pole #'s.	1-¼" x.083"x.2187	P20N	9309485	5477145
Aluminum – For wood pole caps & reflectors.	1-½"x.145"	P20N1	9319740	5477148
Galvanized Steel – For wood pole #'s.	1 ¼" x .083	P20N2	9391578	N/A

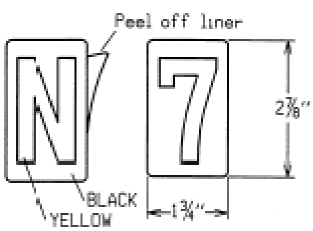
TAG, 3" NUMBER OR LETTER

3" high, stamped and embossed aluminum letters and numbers for pole identification, etc.

LETTERS	STD ITEM	SAP ITEM ID	PS ITEM ID
A	P21A1	9319609	8002150
B	P21A1	9319608	8002151
C	P21A1	9319607	8002152
D	P21A1	9319606	8002153
E	P21A1	9319605	8002154
F	P21A1	9319604	8002155
G	P21A1	9319603	8002156
H	P21A1	9319602	8002157
I	P21A1	9319601	8002158
J	P21A1	9319600	8002159
K	P21A1	9319599	8002160
L	P21A1	9319577	8002161
M	P21A1	9319576	8002162
N	P21A1	9319575	8002163
O	P21A1	9319574	8002164
P	P21A1	9319552	8002165
Q	P21A1	9319682	8002166
R	P21A1	9319699	8002167
S	P21A1	9319698	8002168
T	P21A1	9319697	8002169
U	P21A1	9320515	8002170
V	P21A1	9320493	8002171
W	P21A1	9320492	8002172
X	P21A1	9320449	8002173
Y	P21A1	9319694	8002174
Z	P21A1	9319693	8002175
NUMBERS			
1	P21A2	9320029	8002326
2	P21A2	9320028	8002327
3	P21A2	9320027	8002328
4	P21A2	9320026	8002329
5	P21A2	9320025	8002330
6 OR 9	P21A2	9320024	8002331
7	P21A2	9320023	8002332
8	P21A2	9320022	8002333
0	P21A2	9320021	8002335
½	P21A2	9314318	0810550
DASH -	P21A3	9320020	8002336

NUMBER OR LETTER, 2⅞" REFLECTIVE VINYL

1 ¾" x 2⅞" reflective vinyl markers for switch identification. Self adhesive high-intensity grade encapsulated-lens sheeting with liner. Yellow characters on black backing.

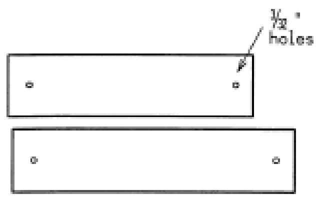


LETTERS	STD ITEM	SAP ITEM ID	PS ITEM ID
A	P21L	9319855	8002601
B	P21L	9319854	8002602
C	P21L	9319853	8002603
D	P21L	9319852	8002604
E	P21L	9321576	8002605
F	P21L	9321593	8002606
G	P21L	9309331	8002607
H	P21L	9321595	8002608
I	P21L	9319971	8002609
J	P21L	9319969	8002610
K	P21L	9319968	8002611
L	P21L	9319967	8002612
M	P21L	9319966	8002613
N	P21L	9321610	8002614
O	P21L	9321609	8002615
P	P21L	9321608	8002616
Q	P21L	9321607	8002617
R	P21L	9321606	8002618
S	P21L	9321605	8002619
T	P21L	9321604	8002620
U	P21L	9321603	8002621
V	P21L	9321602	8002622
W	P21L	9321601	8002623
X	P21L	9321600	8002624
Y	P21L	9321599	8002625
Z	P21L	9321598	8002626
PHRASE			
A PHASE	P21L	9389776	
B PHASE	P21L	9389765	
C PHASE	P21L	9389755	
NUMBERS			
0	P21N	9319866	8002700
1/2	P21N	9308115	9202206
1	P21N	9309423	8002701
2	P21N	9321689	8002702
3	P21N	9321688	8002703
4	P21N	9321687	8002704
5	P21N	9321686	8002705
6	P21N	9321685	8002706
7	P21N	9321684	8002707
8	P21N	9321683	8002708
9	P21N	9321682	8002709
- (DASH)	P21N	9306266	9201878

PANEL, MOUNTING

For mounting self sticking numbers and letters (std item P21L & P21N).

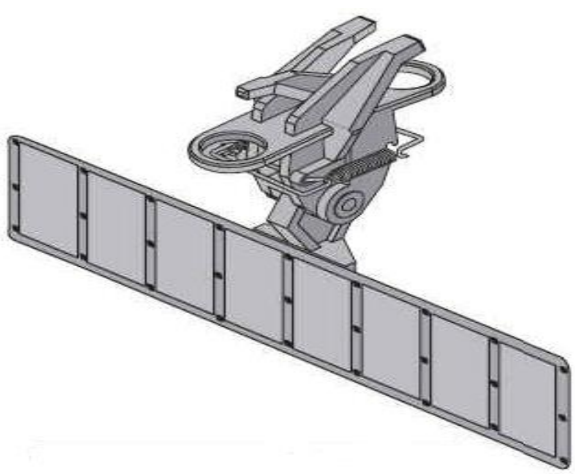
DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Black vinyl, self adhesive with liner.			
3” X 11½” X 0.011”	P21M	9319772	8002402



DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Non-adhesive XP laminated phenolic with two mounting holes.			
3” X 12” X $^1/_{16}$”	P21R12	9319766	8002420
3” X 15” X $^1/_{16}$”	P21R15	9315136	0810186
3” X 19” X $^1/_{16}$”	P21R19	9310709	9200633

SIGN, CLAMP ON

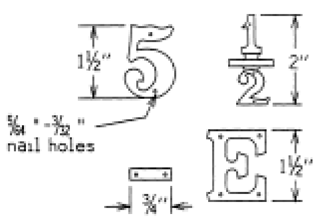
Sign clamp-on 8 panel horizontal hot stick installation to be used with in-line disconnects Std 12-138



STD ITEM	SAP ITEM ID	PS ITEM ID
P21S	9387098	NONE

TAG, 1½" NUMBER OR LETTER

1½" high stamped and embossed aluminum letters and numbers for numbering wood poles.



LETTERS	STD ITEM	SAP ITEM ID	PS ITEM ID
A	P22A1	9319692	8002176
B	P22A1	9319691	8002177
C	P22A1	9319690	8002178
D	P22A1	9319689	8002179
E	P22A1	9319688	8002180
F	P22A1	9319687	8002181
G	P22A1	9319686	8002182
H	P22A1	9319685	8002183
I	P22A1	9319684	8002184
J	P22A1	9319683	8002185
K	P22A1	9319661	8002186
L	P22A1	9319680	8002187
M	P22A1	9319660	8002188
N	P22A1	9319445	8002189
P	P22A1	9309334	8002191
Q	P22A1	9319444	8002192
R	P22A1	9319443	8002193
S	P22A1	9319442	8002194
T	P22A1	9319441	8002195
U	P22A1	9319440	8002196
V	P22A1	9319439	8002197
W	P22A1	9319438	8002198
X	P22A1	9319616	8002199
Y	P22A1	9319615	8002204
Z	P22A1	9319433	8002209
NUMBERS			
1	P22A2	9319437	8002316
2	P22A2	9309114	8002317
3	P22A2	9319436	8002318
4	P22A2	9319435	8002319
5	P22A2	9319907	8002320
6 OR 9	P22A2	9319885	8002321
7	P22A2	9319884	8002322
8	P22A2	9319883	8002323
0	P22A2	9320030	8002325
½	P22A2	9320013[Y]	8002360[Y]
DASH -	P22A3	9320019	8002337

SIGN, NOT IN PHASE

Self sticking, 2½" x 11½" long plastic film with a clear polyurethane coating. Black characters on a yellow background. Mounted on a peel-off adhesive-protecting liner. For use with U.G. & O.H. distribution transformers.

STD ITEM	SAP ITEM ID	PS ITEM ID
P22P	9319410	8002214

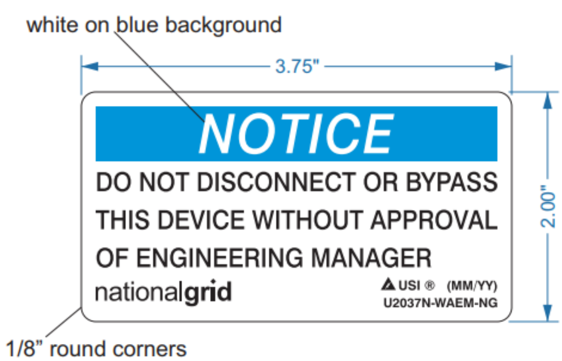
DECAL, TRANSFORMER VENT

2" X 7" Subsurface printed polyester self-sticking decal; "vent tank before opening fuse" yellow printing and border on a black background mounted on a liner to protect the adhesive until removal.

STD ITEM	SAP ITEM ID	PS ITEM ID
P22T	9319769^{Y}	8002412^{Y}

MARKER, NOTICE – DO NOT DISCONNECT OR BYPASS

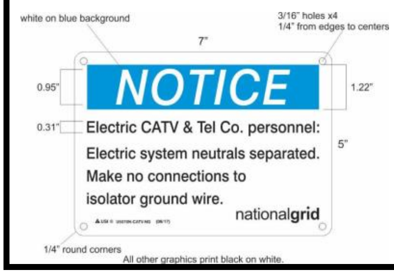
Label, pressure sensitive vinyl decal, NOTICE – white letters on blue background, all other letters – black on white background.



STD ITEM	SAP ITEM ID	PS ITEM ID
P22U	9315133	0810204

SIGN, NOTICE – ELECTRIC SYSTEM NEUTRALS SEPARATED

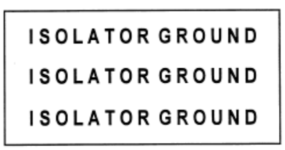
Label, NOTICE – 3.75" X 5.75", aluminum baked enamel with urethane, NOTICE – white letters on blue, all other letters black on white.



STD ITEM	SAP ITEM ID	PS ITEM ID
P22V	9314907	0810206

MARKER, CABLE – ISOLATOR GROUND

4 ¾" X 8" X 0.010" vinyl. Black letters on yellow for use on special isolated neutral poles.
0.5" – 1".



STD ITEM	SAP ITEM ID	PS ITEM ID
P22W	9315143	0810205

SIGN – ELECTRICAL SAFETY DESIGNATION

Dangerous – Keep Away, 14" X 20" W high intensity reflective sign on aluminum base, black letters on white background, "DANGER" to be white on red background. For use on wood poles and structures on right-of-ways in Massachusetts ONLY.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Rigid	P23B1	9302619E	5483458E
Flexible	P23B2	9302633E	5483462E
Adhesive	P23B3	9302632E	5483466E

SIGN – ELECTRICAL SAFETY DESIGNATION

Dangerous – Keep Off, 14" X 20" W high intensity reflective sign on aluminum base, black letters on white background, "DANGER" to be white on red background. For use on wood poles and structures on right-of-ways throughout PPL except for Massachusetts. For Massachusetts see P23B1 & P23B2.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Rigid	P23C1	9302631	5483470
Flexible Base	P23C2	9302630	5483474

SIGN – NOTICE, SEE BULLETIN

Sign, notice, see bulletin in control cabinet prior to performing work.

STD ITEM	SAP ITEM ID	PS ITEM ID
P23CC	9390365	N/A

SIGN – NOTICE, SEE BULLETIN

Sign, notice, equipment participates in centralized control scheme, follow all procedures prior to operating or performing work.

STD ITEM	SAP ITEM ID	PS ITEM ID
P23CS	9392555	N/A

HOLDER, TAG

If used, the aluminum wood pole tag holder for wood poles shall be placed in a location making it inaccessible to the public (8' min. height from final grade, fenced in, etc.). 2½" wide x 4¼" long.

STD ITEM	SAP ITEM ID	PS ITEM ID
P23E	9309618	5473850

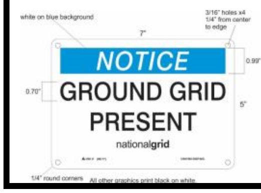
SIGN – CAUTION FLOATING WYE/DELTA INSTALLATION

"CAUTION FLOATING WYE/DELTA INSTALLATION, CLOSE THE NEUTRAL GROUNDING SWITCH BEFORE SINGLA PHASE SWITCHING OCCURS", 4 inches by 6 inches with 4 holes (0.125 inch diameter), made of co-extruded polymer, yellow base with black extruded lettering.

STD ITEM	SAP ITEM ID	PS ITEM ID
P23F	9306597	9201725

SIGN - GROUND GRID PRESENT

4 inch by 6 inch with 4 holes, (.125 inch diameter), one hole in each corner, made of co-extruded polymer, white letters on blue or black letters on white.



STD ITEM	SAP ITEM ID	PS ITEM ID
P23G	9308347	9201741

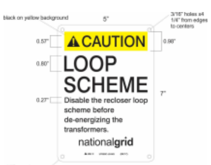
SIGN – WARNING HAND DIG ONLY

Sign, warning hand dig only, underground utilities in the immediate area, 5inx7in, with 4 holes 0.125in dia in each corner, u2450p polycarbonate, reflective, per MS0109.

STD ITEM	SAP ITEM ID	PS ITEM ID
P23HD	9391366	N/A

SIGN – CAUTION LOOP SCHEME

“CAUTION LOOP SCHEME DISBLE THE RECLOSER LOOP SCHEME BEFORE DE-ENERGIZING THE TRANSFORMERS”, 4 inches by 6 inches with 4 holes (.25 inch diameter), made of co-extruded polymer, yellow base with black extruded lettering.



STD ITEM	SAP ITEM ID	PS ITEM ID
P23LS	9308364	9201742

SIGN – DANGER OVERHEAD POWER LINES

Sign, danger, overhead power lines, keep clear. Can be used for awareness on distribution poles with transmission lines in close proximity.

STD ITEM	SAP ITEM ID	PS ITEM ID
P23OPL	9391769	N/A

SIGN – NOTICE SUPPLEMENTAL PPE REQUIRED

Sign, notice, supplemental PPE required when switching operations is performed from the ground, switchman shall wear EH overshoes rated at 15kv or greater, 5inx7in.

STD ITEM	SAP ITEM ID	PS ITEM ID
P23S	9390983	N/A

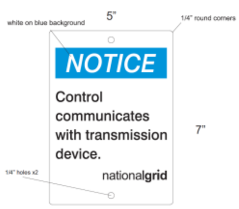
TAG. POLE MARKER

2” H X 2½” W X 1⁄64” defective pole marker. Painted aluminum with two nail holes for field attachment to deteriorated wood poles. Red background with white or aluminum colored arrow.

STD ITEM	SAP ITEM ID	PS ITEM ID
P24	9314344	0810101

SIGN – NOTICE CONTROL COMMUNICATES WITH TRANSMISSION DEVICE

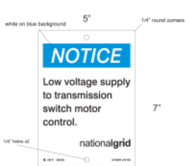
Sign, notice control communicates with transmission device. Approximate size 7” x 5” Material: flexible reflective polycarbonate



STD ITEM	SAP ITEM ID	PS ITEM ID
P23T	9393395	N/A

SIGN – LOW VOLTAGE SUPPLY

Sign, low voltage supply to transmission switch motor control. Approximate size 7” x 5” Material: flexible reflective polycarbonate.



STD ITEM	SAP ITEM ID	PS ITEM ID
P23T2	9393443	N/A

TAG, ROCK ANCHOR INSTALLED

Sign indicating use of pole rock anchors with two nail holes for field attachment to wood poles where rock anchors (Std Item P14A) are installed. Yellow background with black lettering.

STD ITEM	SAP ITEM ID	PS ITEM ID
P25	9307547	9202879

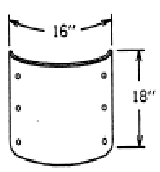
DECAL, WARNING, RECLOSER WITH DTT

Decal, Warning, Recloser with DTT. Recloser with direct transfer trip, label to be installed on the outside of the control panel door.

STD ITEM	SAP ITEM ID	PS ITEM ID
P25PR	9307756	9202987

GUARD, POLE HUB

Galvanized steel 16" X 18" X ⅛", EEI Standard TD12. Item 2.



STD ITEM	SAP ITEM ID	PS ITEM ID
P26G	9311950Y	3502147Y

KIT – CLEARANCE AND CONTROL TAGGING

Kit, clearance and control tagging, includes plastic case with Company logo, and custom foam insert for tags.

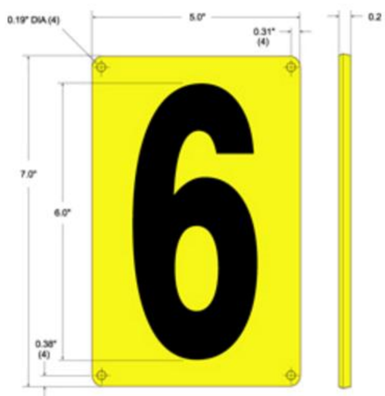
STD ITEM	SAP ITEM ID	PS ITEM ID
P30	9391886	N/A

PAINT

DESIGNATION	DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
N.M. #32	Black tower paint. One gallon. Use for protecting surface of friction tape.	P32	9314490Y	1008032Y

TAG, 5" WIDE X 7" HIGH, NUMBER OR LETTER

5" wide X 7" high, poly, black letter on yellow background for aerial identification.



LETTERS	STD ID	SAP ITEM ID	PS ITEM ID
A	P33A1	9310748	5105803
B	P33A1	9310979	5105804
C	P33A1	9310978	5105805
D	P33A1	9310977	5105806
E	P33A1	9310976	5105807
F	P33A1	9310975	5105808
G	P33A1	9310974	5105809
H	P33A1	9310973	5105810
I	P33A1	9310980	5105811
J	P33A1	9310990	5105812
K	P33A1	9310991	5105813
L	P33A1	9310992	5105814
M	P33A1	9311009	5105815
N	P33A1	9311008	5105816
O	P33A1	9310737	5105802
P	P33A1	9311007	5105818
Q	P33A1	9319617	5105819
R	P33A1	9311006	5105821
S	P33A1	9311005	5105822
T	P33A1	9311004	5105823
U	P33A1	9311003	5105824
V	P33A1	9310926	5105825
W	P33A1	9310925	5105826
X	P33A1	9310924	5105827
Y	P33A1	9310923	5105828
Z	P33A1	9310922	5105829
NUMBERS			
1	P33A2	9310841	5105793
2	P33A2	9310840	5105794
3	P33A2	9310735	5105795
4	P33A2	9310734	5105796
5	P33A2	9310733	5105797
6 OR 9	P33A2	9310732	5105798
7	P33A2	9310731	5105799
8	P33A2	9310730	5105801
0	P33A2	9310737	5105802
DASH -	P33A3	9389455	N/A

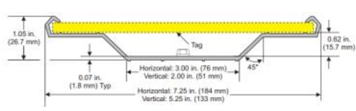
AERIAL HAZARD SIGN

Aerial hazard warning sign, 20" X 20", uv resistant polycarbonate with Type 1 (Engineer Grade). Use two, B9N1 lag screws for mounting. Twelve 7/16" diameter holes provided for correct orientation.

DESCRIPTION	STD ID	SAP ITEM ID	PS ITEM ID
Black letter on yellow background	P34A	9387937	N/A
White letter on red background	P34B	9387936	N/A

AERIAL SIGNAGE CHANNEL

3 Position aluminum channel for 5" x 7" aerial signage P33A1.



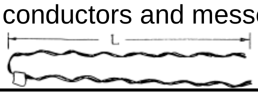
STD ID	SAP ITEM ID	PS ITEM ID
P35	9310510	5473853

GUARD, PREFORMED LINE

DESCRIPTION	ROD LENGTH, (IN)	DIA RANGE, (IN)	ROD DIA, (IN)	STD ITEM	SAP ITEM ID	PS ITEM ID
#1/0 ACSR – 6/1	25	0.390 - 0.413	0.121	P51C	9314043	3506727
336.4 ACSR – 18/1	35	0.680 - 0.703	0.146	P51G	9314041	3506731
795 AAC – 37 Strand	47	1.017 – 1.064	0.182	P51K	9307907	9202853
#1/0 AAAC – 7 Strand	37	0.390 – 0.413	0.121	P51L	9307906	9202854
336.4 AAC – 19 Strand	47	0.656 – 0.679	0.146	P51M	9307905	9202855
336.4 ACSR – 18/1	47	0.680 – 0.703	0.146	P51N	9307904	9202856
477 AAC – 19 Strand	51	0.793 – 0.840	0.146	P51P	9307903	9202857
477 ACSR – 26/7	53	0.841 – 0.898	0.146	P51Q	9307902	9202858
795 AAC – 37 Strand	59	1.017 – 1.064	0.182	P51R	9307901	9202859
795.0 ACSR - 54/7	49	1.065 - 1.098	0.204	P51U	9313182	5989468
1113.0 ACSR - 54/19	53	1.269 - 1.327	0.250	P51V	9307382	9200410

DEADEND, PREFORMED

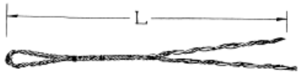
Stranded wire connectors for terminating primary or secondary spans. Aluminum coated steel for bare conductors and messengers. Not to be reused.



APPLICATION	LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
#4 ACSR 7/1 Full Tension	17” – 22”	P52A1	9312413[Y]	3506197[Y]
#4 ACSR 6/1 Lt. Duty – For Services Only	11” – 13”	P52A2	9311555[Y]	3506199[Y]
#2 AAAC 7 Str. Full Tension	24”	P52B1	9314663[Y]	0811112[Y]
#2 AAAC 7 Str. Lt. Duty	15”	P52B2	9314646	0811111
4/0 SAAC Full Tension	32” – 35”	P52F	9315815	3506715
336.4 SAAC Full Tension	44”	P52G	9315814	3506716
1/0, 7 Str. Al., 0.170 PE Spacer Cable		P52J2	9309140	3506748
1/0 ACSR & 6201 Full Tension	26”	P52J3	9311495	3506750
1/0 ACSR 6/1 & 6201 7 strand Lt. Duty for Services Only	19”	P52J4	9311494	3506751
336.4 And 477.0 Spacer Cable	45”	P52L2	9315735	3506749
477.0, 19 Str. EC-Compact, 35KV		P52M	9313346[E]	5989151[E]
1/0, 7 str. EC-Compact, 15kV		P52P	9313348[E]	5989145[E]

GRIP, PREFORMED GUY OR MESSENGER DEADENDS

Stranded full tension preformed wire dead-ends. 3 or 7 strand B galvanized steel for bare conductors, guys and messengers.



APPLICATION	COLOR CODE	LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
For maintenance on ¼”	Yellow		P54A		3543554
For maintenance on 1/0 – 4/3 AWAC	Yellow		P54AA	9313350[E]	5989142[E]
For maintenance on ⅜”, 7 - #8 CW	White		P54AB	9320255[E]	5989135[E]
6M 5⁄16” Utility Grade GS (Std. Item No. G15A)	Black	25” – 31”	P54B	9313474	3503555
10M ⅜” Utility Grade GS (Std. Item No. G15A)	Orange	27” – 35”	P54C	9313473	3503556
16M 7⁄16” Utility Grade GS (Std. Item No. G17A)	Green	33” – 38”	P54D	9313472[Y]	3503557[Y]
12.5M 7 Str. #9 Alumoweld (Std. Item No. G16A)	Yellow	29”	P54E	9314657	0811119
16M 7⁄16” EHS CW (Std. Item No. G17B)	Yellow	36”	P54H	9313470	3503567
2/0 AWAC 5/2 STR, NO.1 AWAC 2/5 STR, 1/0 AWAC ¾ STR	Blue	35”	P54J	9313477	3503569

DEADEND, AUTOMATIC SERVICE

For deadending services only.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
#6 Copper service cable – house and pole ends.	P55A1	9303025[E]	5967605[E]
#2 and 1/0 Aluminum service cable – house and pole ends.	P55A2	9303024	5967992
#4 Aluminum service cable – house and pole ends.	P55B	9313341	5967991

POLES, FIBERGLASS

Distribution fiberglass pole. Standard duty with climbing attachments for tangent, backyard and guyed applications. Heavy duty for unguyed ‘Self Supporting’ applications. Poles shall comply with MS2010.

POLE LENGTH, POLE CLASS	STD ITEM	SAP ITEM ID	PS ITEM ID	CATEGORY	COLOR
35 FT, Class 4	P77A4	9306760	9201670	Standard Duty	Brown/Bronze
40 FT, Class 3	P77B3	9306761	9201671	Standard Duty	Brown/Bronze
45 FT, Class 2	P77C2	9306778	9201672	Standard Duty	Brown/Bronze
45 FT, Class H4	P77DH4	9389020	N/A	Heavy Duty	Gray
50 FT, Class H5	P77DH5	9389022	N/A	Heavy Duty	Gray
55 FT, Class H6	P77DH6	9389023	N/A	Heavy Duty	Gray

STEP, REMOVABLE

Galvanized steel removable step used for fiberglass pole installations.

STD ITEM	SAP ITEM ID	PS ITEM ID
P78	9315123	0808639

KIT, WOODPECKER HOLE REPAIR

Epoxy filler kit, mix in bag style, for repairing woodpecker holes on wood poles. Includes clip-pack and 1, 12” x 12” cloth cover. Summer Kit: For application in temperatures between 65°F and 100°F. Winter Kit: For application in temperature below 65°F.

STD ITEM	SAP ITEM ID	PS ITEM ID	TYPE
P80	9306254	9202073	Summer
P80C	9386502	9202997	Winter
P80D	9386522	9202998	Additional Cloth

KIT, WOODPECKER HOLE REPAIR

Epoxy filler kit, Timberbond NSG cartridge style for repairing woodpecker holes on wood poles. To be used with twin tube applicator Power Push 7000. Applicator comes with battery and charger. Apply at any temperature (product must be stored at room temperature prior to use.)

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
PowerPush 7000 Applicator	P80a	9390166	N/A
Timberbond NSG Twin Cartridge	P80B	9388967	N/A

KIT, POLE FOAM.

Includes 2 liquids needed to create foam and a pair of vinyl gloves to wear during application.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
3 cubic feet	P85A	9308034	9202187
6 cubic feet	P85B	9308033	9202188

REGULATOR, VOLTAGE

Automatic single phase step-type pole or platform mounted voltage regulator. For bi-directional application on all 2.4 through 7.9 kV primary circuits. Includes control cabinet and 40 ft. control cable. Shall comply with latest MS2821 and ANSI C57.15.

NOTE:
Regulators are designed to regulate 10% of the total circuit power.
(167 kVA @ 7620V = 21.9A or 10% of that unit's 219A cont. max. load).

KVA RATING	MAXIMUM CONTINUOUS LOAD	MAXIMUM WEIGHT (LBS.)	A	STD ITEM	SAP ITEM ID	PS ITEM ID
76.2	100A	1500	24”	R40A1	9300399	4275590
167	219A	2000	36”	R40B1	9300403	4278590
333	437A	3500	36”	R40C1	9300241	9201657

REGULATOR, LOW VOLTAGE IN-LINE POWER

Low voltage pole-mounted 50kVA In-line Power Regulator. Solid state 120/240V voltage regulator with load voltage regulation under forward and reverse power flow, Reactive power compensation, load voltage and source current harmonic cancellation (3rd to 7th harmonic), power quality monitoring, autonomous operation, or local or remote (centralized) management, built-in bypass mechanism, operating temperature: -40° to 55°C andNEMA-4 enclosure.

STD ITEM	SAP ITEM ID	PS ITEM ID
R40S	9390771	N/A

REGULATOR CONTROL – M-2001D

Replacement comprehensive control with LCD display for standard regulators utilizing existing control cabinet. 120V AC provides bi-directional capability without additional P.T.

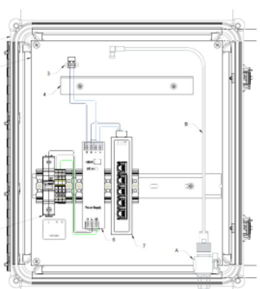
DESCRIPTION	REGULATOR	STD ITEM	SAP ITEM ID
CABINET + CONTROL	Howard, GE, Siemens	R41A	9390949
CABINET + CONTROL	Cooper	R41C	9390948
STANDALONE CONTROL	All w/ correct adapter panel	R42A	9391264

<u>REGULATOR CONTROL ADAPTER PANEL</u>

ADAPTER PANEL	STD ITEM	SAP ITEM ID	PS ITEM ID
Cooper	R42C	9315135	0810187
GE	R42G	9315142	0810191
Siemens	R42S	9315134	0810192
Howard	R42T	9389646	N/A

<u>REGULATOR, COMMUNICATION CABINET</u>

Regulator Communication Cabinet for multi-phase voltage regulator installations to use one radio.



	STD ITEM	SAP ITEM ID
	R43C	9393738

<u>REGULATOR, CONTROL CABLE</u>

Replacement control cable for old General Electric regulators. 40 ft. length.

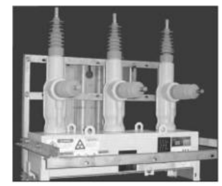
CONNECTOR	STD ITEM	SAP ITEM ID
Shorting Pin	R43GS	9391625
J2 and J3 Molex	R43GM	9391628

RECLOSER, THREE PHASE WITH CONTROL & CABINET (560A)

560A microprocessor controlled recloser. Requires 120V supply (+3% / -20%). Includes pole mounting hardware and double-size control cabinet.

VOLTAGE	APPLICATION	STD ITEM	SAP ITEM ID	PS ITEM ID
15kV, 10kA sym.	Radial	R50A	9312197	6486723
15kV, 10kA sym.	Loop Scheme	R50E	9309201	5100154
35kV, 8kA sym.	Radial	R50F	9312195	6486915
35kV, 8kA sym.	Loop Scheme	R50G	9308787	5100152

RECLOSER, THREE PHASE WITH CONTROL & CABINET (800A) - MAINTENANCE ONLY

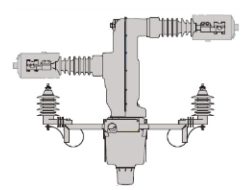


800A continuous rated microprocessor controlled recloser. Rated 12.5kA symmetric fault interrupting. Includes pole mounting hardware and stainless steel control cabinet. Per latest Spec. PPL MS2750.

VOLTAGE	CONTROL	APPLICATION	STD ITEM	SAP ITEM ID	PS ITEM ID
*15kV	SEL651R	Radial	R50AA	9306582	9201979
**12.47kV w/ PT's	SEL651R	Radial	R50A1	9306588[E]	9201973[E]
**13.2kV w/ PT's	SEL651R	Radial	R50A2	9306586	9201974
**13.8kV w/ PT's	SEL651R	Radial	R50A3	9306585[E]	9201975[E]
*15kV	SEL651R	Loop Scheme	R50EE	9306581	9201980
***12.47kV w/ Sensing & PT's	SEL651R	Loop Scheme	R50E1	9306525[E]	9201970[E]
***13.2kV w/ Sensing & PT's	SEL651R	Loop Scheme	R50E2	9306524	9201971
***13.8kV w/ Sensing & PT's	SEL651R	Loop Scheme	R50E3	9306523[E]	9201972[E]
*35kV	SEL651R	Radial	R50FF	9306580	9201981
*35kV (SubT)	SEL651R	Radial	R50FS	9306447[Y]	9201809[Y]
*35kV	SEL651R	Loop Scheme	R50GG	9306583	9201978
*35kV (SubT)	SEL651R	Loop Scheme	R50GS	9306446[Y]	9201810[Y]
35 kV (SubT) w/ Line and Load voltage Sensing	SEL651R	Sectionalizer	R50HA	9386620[Y]	9203061[Y]

**Requires 120V supply (+3% /-20%).*
***Includes voltage specific instrument PT's to meet control power supply requirements. Use a 3K fuse link for primary fuses feeding PT's.*
****Includes integrated voltage sensing in Source 1 bushings and voltage specific instrument PT's to . meet control power supply requirements*

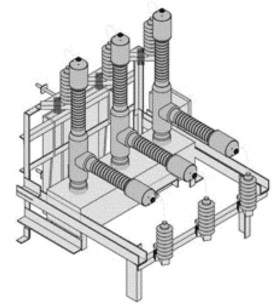
RECLOSER, SINGLE PHASE WITH CONTROL & CABINET (800A)



800A continuous rated microprocessor controlled recloser. Rated 12.5kA symmetric fault interrupting. Includes pole mounting hardware, 10 pin Control cable, Voltage Supply Cable and stainless steel control cabinet. Requires 120V supply. Per latest Spec. PPL MS2750.

VOLTAGE	CONTROL	APPLICATION	STD ITEM	SAP ITEM ID	PS ITEM ID
15kV	SEL-351RS Kestrel	Radial	R50SP	9388969	-

RECLOSER, THREE PHASE (800A) 800amp continuous rated microprocessor controlled recloser. Rated 12.5kA symmetric fault interrupting. Includes pole mounting hardware. Per PPL MS2750.



System Voltages	Package	Description	Mechanism	
			SAP Item ID	STD Item ID
3,740GRDY/2160 4,160GRDY/2,400	D	Viper (6IVS) with frame mounted line/load PTs	9392285	R50S15B
12,470GRDY/7,200 13,200GRDY/7,600 13,800GRDY/7,960	C	Viper (6IVS) with frame mounted line/load PTs	9392244	R50S15C
24,940GRDY/14,400 34,500GRDY/19,900 23,000Y 34,500Y	E	Viper (6IVS) - 38kv (External PT required)	9392284	R50S38A
2,400Δ 8,320GRDY/4,800 4,800Δ 7,200Δ 11,000Δ 12,000Δ 13,800Δ	A	Viper S - 15kV (External PT required)	9392283	R50S15A
23,000Δ 34,500Δ	B	Viper S - 38kV (External PT required)	9392282	R50S38B

RECLOSER, THREE PHASE (800A) 800amp continuous rated microprocessor controlled recloser. Rated 12.5kA symmetric fault interrupting. Includes Six Integrated Voltage Sensing (6IVS). Per PPL MS2750.

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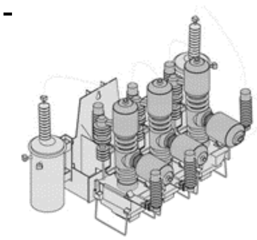


System Voltages	Package	Description	Mechanism	
			SAP Item ID	STD Item ID
3,740GRDY/2160 4,160GRDY/2,400	P	NOVA NX-T with frame mounted line/load PTs	9392582	R50SE15B
12,470GRDY/7,200 13,200GRDY/7,600 13,800GRDY/7,960	Q	NOVA NX-T with frame mounted line/load PTs	9392618	R50SE15C
24,940GRDY/14,400 34,500GRDY/19,900 23,000Y 34,500Y	R	NOVA NX-T - 38kv (External PT required)	9392564	R50SE38A

CONTROL, RECLOSER (FOR 560A RECLOSERS)

Form 6 recloser control complete with cables, junction box, and accessories. For use on all 35kV and below applications.

APPLICATION	STD ITEM	SAP ITEM ID	PS ITEM ID
Radial	R51A	9307380	9200415
Loop Scheme	R51B	9307379	9200416

CONTROL, RECLOSER (FOR 800A 3 PHASE RECLOSERS)

SEL recloser control complete with cabinet, cables and accessories. For use on all 35KV and below applications per PPL MS2750.

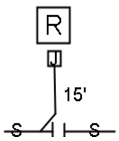
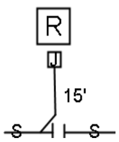
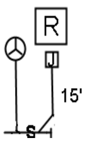
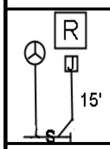
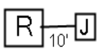
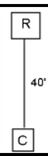
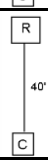
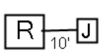
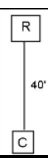
APPLICATION	STD ITEM	SAP ITEM ID	PS ITEM ID
G&W Viper – S Recloser	R51B2	9392281	-
Cooper/Eaton NOVA NX-T 6IVS Recloser	R51B3	9392580	-

CELLULAR RADIO MODEM

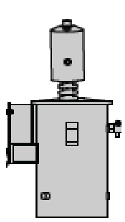
Modem, 4G LTE-4G/3G (VERIZON) Cellular Radio Modem for communication in remote devices including overhead reclosers on the distribution system. Requires antenna kit and conversion kit.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Cellular Radio Modem	R51C	9389636	N/A
Antenna Kit for above	R51C1	9389708	N/A
High gain Antenna Kit	R51C2	9391629	N/A
Conversion Kit	R51C5	9392253	N/A

CABLES FOR USE WITH 800A RECLOSER
Designed for use with 800A recloser head unit and Schweitzer SEL-651R recloser control.

	DESCRIPTION	APPLICATION	STD ITEM	SAP ITEM ID	PS ITEM ID
	Secondary Supply Cable, 15 ft, 2 conductor, LINE	Radial scheme recloser application	R52A	9307582	9202485
	Secondary Supply Cable, 15 ft,2 conductor, LOAD	Radial scheme recloser application	R52B	9307584	9202484
	Secondary Supply Cable, 15 ft,4 conductor, LINE	Loop Scheme recloser application, 3 Phase	R52C	9307568	9202483
	Secondary Supply Cable, 15 ft, 4 conductor, LOAD	Loop scheme recloser application, 3 Phase	R52D	9307940	9202338
	3 Phase Voltage Sensing Cable	3 phase voltage sensing cable for voltage specific LS reclosers.	R52E	9307939	9202337
	Recloser Voltage Supply Cable, 19 Pin, Armored, BLUE, 40 FT Length	Replacement Voltage supply cable between the Viper and Schweitzer SEL-651R control.	R52I	9386987	
	Recloser Control Cable, 14 Pin, Armored, YELLOW, 40 FT Length	Replacement control cable between the Viper and Schweitzer SEL-651R control.	R52J	9386988	
	AC power cable for Viper J-box to Head unit	Replacement Voltage cable between the Viper and Junction box.	R52K	9389570	
	Recloser Control Cable, 42 Pin, Armored,40 FT Length	Control cable between the NOVA NX-T mechanism and Schweitzer SEL-651R control.	R52K1	9392587	-

VOLTAGE SPECIFIC FRAME-MOUNTED POTENTIAL TRANSFORMERS (PT's)

	VOLTAGE	APPLICATION	STD ITEM	SAP ITEM ID	PS ITEM ID
	7200/12470V *	Replacement or retrofitting 800A G&W recloser units (includes sec cable)	R52F	9306528	9201967
	7620/13200V *	Replacement or retrofitting 800A G&W recloser units (includes sec cable)	R52G	9306535	9201968
	7960/13800V *	Replacement or retrofitting 800A G&W recloser units (includes sec cable)	R52H	9306527	9201969

* Note: Potential Transformers to be fused on the primary side @ 3K.

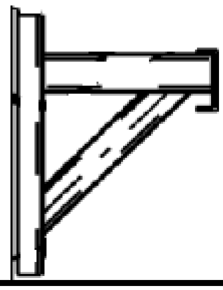
RECLOSER – CUTOUT MOUNTED

Cutout mounted 15 kV, 100 amp recloser is self-powered, electronically controlled, single phase, vacuum fault interrupter mounted with the included factory shipped fuse cutout. Symmetrical Interrupting rating is 6300 amperes. Includes Polymer cutout mounting.

SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
FACTORY PROGRAMMED			
40K	R53A	9387110[E]	N/A
65K	R53B	9387111[E]	N/A
100K	R53C	9387112[E]	N/A
USER PROGRAMMABLE			
	R53G	9392057	N/A
CUTOUT REPLACEMENT (CMR ONLY)			
	R53H	9392286	N/A

BRACKET, RECLOSER LADDER

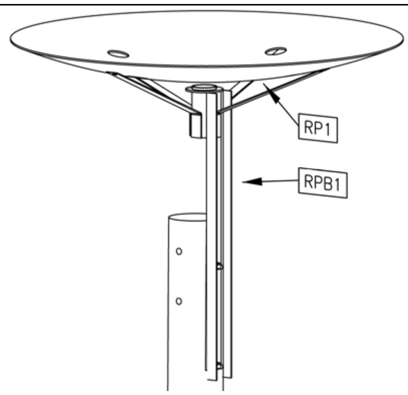
For use where extension ladders are required to access elevated pole mounted control installations. The bracket is made of galvanized steel. Additional equipment required for mounting and bonding: #6 Cu bonding wire (Item ID 4015002), ¾” x 12” through bolt (Item ID 7001556) or ¾”x14” through bolt (Item ID 7001520). Manufactured per MS2230.



STD ITEM	SAP ITEM ID	PS ITEM ID
R55	9307148	5984615

RAPTER NESTING PLATFORM AND BRACKET

For use when relocating raptor nests from electric facilities. Platform is made of UV resistant fiberglass and is 63-inches in diameter, 6-inch depth, ¼-inch thick, 9 drain holes and weighs 52 lbs. Bracket is made of aluminum channel and is 46-inches in height. Platform and bracket stocked as separate items.



DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
FIBERNEST PLATFORM	RP1	9390176	N/A
BRACKET	RPB1	9390175	N/A

MOLDING, POLYETHYLENE

Black UV resistant plastic molding for use with S33B staples over bare or covered down ground wires.

SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
½” X 0.100” X 8’6”	S1	9313613	3503053

COMPOUND, SEALING – PLASTIC PUTTY

Moldable, non-hardening, multi-purpose sealing and caulking compound. Grey in color, completely inert with high adhesion and shape retention. For use in sealing openings in conduit, etc.

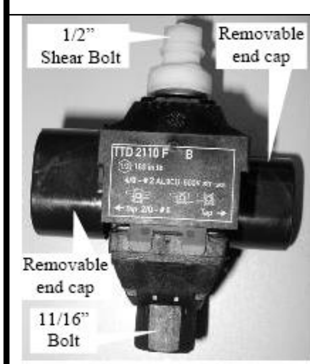
STD ITEM	SAP ITEM ID	PS ITEM ID
S3	9320377	8010262

CONNECTOR, WEATHERPROOF SECONDARY

To be used in coastline salt contaminated areas. The connector can be used to connect aluminum to aluminum, aluminum to copper, and copper to copper secondary/service cables. It can also be used to connect bare secondary/service messengers.

Note: Leave the blue insert intact if the main wire is bare. Remove the blue insert if the main wire is covered.

See Bulletin #10-26 for more information.



Front View

Side View

STD ITEM	RUN	TAP	SAP ITEM ID	PS ITEM ID
S5	1/0 to #8	1/0 to #8	9308203	9201787
S6	4/0 to #2	4/0 to #4	9314553	9202592

CONNECTORS – STANDARD COMPRESSION TAP

Aluminum tap connector for aluminum, ACSR, & steel to same or to Copper. Do not use for Copper to Copper. Individually boxed & compound filled. ANSI C119/4; Class A, Class 3.

	CONDUCTOR RANGE								TOOL						
	RUN				TAP				Y35/Y45		MD6				
	ACSR	STR.	SOL.	STR STEEL / WIRE DIA	ACSR	STR.	SOL.	STR. STEEL / WIRE DIA	DIE	CRIMPS	DIE	CRIMPS	STD ITEM	SAP ITEM ID	PS ITEM ID
	#4 - #6	#3	#6		#4 - #6	#3	#6		U-O	2	W-O	4	S13B	9312301	3507102
	#4 - #6	#2 - #6				#8	#14				BG	3	S13D	9312300[Y]	3507104[Y]
	1/0 - #2	2/0 - #1				#8	#14		U-O	2	W-O	4	S13E	9312299[Y]	3507105[Y]
	1/0 - #3	2/0 - #2		4/16" – 7/16"	#2 - #6	#2	#6 - #4		U-O	2	W-O	5	S13H	9312298	3507108
	2/0 – 1/0	2/0 – 1/0		.477" - .365"	#2 - #4	#1 - #3	#2	.332" – .236"	U-D3	2	D3	5	S13HD	9315227[Y]	0804299[Y]
	1/0	2/0 – 1/0		3/8" – 7/16"	1/0	2/0 – 1/0		3/8" – 7/16"	U-D3	2	D3	5	S13J	9314950	3507110
	397 – 266	477 – 250			4/0 – 2/0	4/0 – 2/0			U-N	3			S13K	9312297	3507111
	4/0 – 3/0	4/0 – 3/0			4/0 – 3/0	4/0 – 3/0			U-D3	3	D3	7	S13KI	9315733	3507117
	4/0 – 3/0	4/0			2/0 - #1	2/0 – 1/0			U-D3	3			S13L	9312296	3507112
	4/0 – 3/0	4/0			#2 - #6	#1 - #6	1/0 - #6		U-D3	2	D3	5	S13LI	9312295	3507113
	397 – 266	400 – 250			1/0 - #6	2/0	#6		U-N	2			S13N	9312315	3507120
	477 – 4/0	500 – 4/0			477 – 4/0	500 – 4/0			U-N	4			S13P	9312333[Y]	3507119[Y]
	477 - 795	600 – 900		.879" – 1.108"	1/0 - 336	2/0 - 350	2/0 - 350	.398" - .684"	U-R*	3			S13R	9315734[Y]	3507115[Y]
	#2 - #6	#2 - #6	#2-#4			#8	#14		U-BG	1	BG	2	S13D6	9312081[Y]	3507304[Y]
	2/0 - #2	2/0 - #1				#8	#14		U-O	1	W-O	2	S13E6	9312080[Y]	3507305[Y]
	397 – 266	477 – 250			4/0 – 2/0	4/0 – 2/0			U-N	3			S13K6	9312314[Y]	3507311[Y]
	4/0 – 3/0	4/0 – 3/0	4/0		4/0 – 2/0	4/0 – 2/0	4/0		U-D3	2			S13KI6	9312584[Y]	3507317[Y]
	4/0 – 1/0	4/0 – 1/0			4/0 – 1/0	2/0 - #4	2/0 - #3		U-D3	2			S13L3	9312559[Y]	3507412[Y]
	397 – 266	400 – 250			397 – 266	400 – 250			U-N	3			S13M6	9312583[Y]	3507318[Y]
	397 - 266	400 - 250			1/0 - #6	2/0	#6		U-N	2			S13N6	9312582[Y]	3507320[Y]
	1/0 - #3	2/0 - #2			#2 - #6	#2	1/0 - #6		U-O	1		4	S13G	9312312[Y]	3507306[Y]

NOTE: For hard drawn solid conductor, roughen up contact surface prior to placing it into the connector by abrading with pliers or scraping with a hacksaw blade.

* - Y45

CONNECTOR, COMPRESSION C

Copper range-taking compression; C-type tap connector for use with overhead copper conductors and/or underground copper and aluminum conductors without inhibitor.

CONDUCTOR RANGE RUN	CONDUCTOR RANGE TAP	MD6	CRIMP	Y35 or Y39 or Y46	CRIMP	PLATING	STD ITEM	SAP ITEM ID	PS ITEM ID
6 Sol. – 4 Str.	8 Sol. – 8 Str.	W-BG	1	U-BG	1	NA	S14A	9312168	3507129
	4 Sol. – 4 Str.	W-BG	1	U-BG	1	NA	S14B	9314949	3507126
2 Sol. – 2 Str.	8 Sol. – 4 Str.	W-C	2	U-C	1	TIN	S14C	9312169	3507128
	2 Sol. – 2 Str.	W-C	2	U-C	1	NA	S14D	9312328	3507127
6 Sol. – 4 Str.	6 Sol. – 6 Str.	BG				TIN	S14E	9313033[E]	5960407[E]
1/0 Sol. – 2/0 Str.	8 Sol. – 2 Str.	O				NA	S14F	9313031	5960411
1/0 Sol. – 2/0 Str.	1/0 Sol. – 2/0 Str.	O		UE-3		TIN	S14G	9313030	5960412
3/0 Str – 4/0 Str.	6 Sol. – 2 Str.	–		U-D3	1	NA	S14H	9315824	3506644
	1/0 Str. – 2/0 Str.	–		U-D3	1	NA	S14J	9315822	3506654
	3/0 Str. – 4/0 Str.	–		U-D3	1	NA	S14K	9315825	3506643
3/0 Str – 250 Str.	3/0 Str – 250 Str.			U997 -1		NA	S14L	9313861	5960428

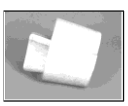
CONNECTOR –FIRED-ON WEDGE TAP CARTRIDGES

Cartridges are for use with fired-on wedge type connectors. The color represents strength of charge and corresponds with color code of taps and other connectors.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Blue	S15CB	9312051[Y]	3507241[Y]
Red	S15CR	9312050[Y]	3507242[Y]
White	S15CW	9315820[Y]	3506672[Y]
Yellow	S15CY	9312049[Y]	3507243[Y]

CONNECTOR –FIRED-ON WEDGE TAPS, ALUMINUM

Powder actuated two-piece (removable) compression tap connectors for aluminum to aluminum or aluminum to copper taps. Connectors to be furnished compound filled, individually packaged and labeled. ANSI C119.4; Class A, Class 3.



CONDUCTOR RANGE		SHELL COLOR CODE	STD ITEM	SAP ITEM ID	PS ITEM ID
RUN	TAP				
1/0 Al. & ACSR	1/0 Al. & ACSR	Blue	S15G	9312048[Y]	3507245[Y]
	#2 Al. & Cu.	White	S15H	9314948[Y]	3507246[Y]
	#4 Al. & ACSR & Cu.	Red	S15J	9312047[Y]	3507247[Y]
336.4 Al. & ACSR	336.4 Al. & ACSR	Blue	S15L	9314114[Y]	0810220[Y]
	336.4 A1. & ACSR	Yellow	S15LL	9312053[Y]	3507260[Y]
	#4/0 Cu.	Blue	S15M	9314115[Y]	0810219[Y]
	#2/0 AWAC.	Blue	S15N	9314116[Y]	0810218[Y]
	#1/0 Al. & ACSR	Blue	S15N1	9314117[Y]	0810217[Y]
	2/0 Al. & ACSR	Yellow	S15NN	9392055**	N/A
	#2 Al. ACSR & Cu.	Blue	S15P	9314118[Y]	0810216[Y]
	#4 Cu.	Blue	S15Q	9306668[Y]	9201643[Y]
	500 Al. & Cu.	Yellow	S15R5	9312046[Y]	3507250[Y]
	750 Al & Cu.	Yellow	S15R7	9314717[Y]	0801961[Y]
750 Al AAC	#4/0 Cu.	Yellow	S15R20	9308205[Y]	9201788[Y]
477 AL AAC or 477 (compact) *	#2 Cu.	Yellow	S15S	9387498	
477 (compact) *	#4/0 Cu.	Yellow	S15T	9315234	
477 AL AAC	#4/0 Cu.	Yellow	S15U	9387500	
477 (compact)*	477 (compact)*	Yellow	S15V	9387555	
477 AL AAC	477 AL AAC	Yellow	S15W	9387504	
477 AL AAC	477 (compact)*	Yellow	S15X	9387503	

** = Can also be used for 4/0 to 4/0 connections
* = Spacer Cable

COVER – FIRED-ON WEDGE

Black polyethylene snap-on insulating covers for fired-on wedge tap connectors.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
For all Red and Blue coded taps.	S15W	9312082[Y]	3507280[Y]
For yellow coded taps sized 336.4 – 556.5 kcmil.	S15Y	9312065[Y]	3507279[Y]
For yellow coded taps sized 795 – 1033.5 kcmil.	S15Z	9308146	9201786

COVER – SPACER CABLE

For spacer cable, cold shrink. Including silicone grease applicator. For applications on all installations except 1/0 15KV . **THIS COVER IS NO LONGER AVAILABLE FROM THE MANUFACTURER. USE GELWRAP C61 OR C62 OR HAND TAPE PER 16.4.60 B.**

STD ITEM	SAP ITEM ID	PS ITEM ID
S16	9306467	5106039

COVER – SECONDARY SERVICE NEUTRAL

For **maintenance** only, this cover is use for secondary service neutral.

STD ITEM	SAP ITEM ID	PS ITEM ID
S16N	9393251[E]	

CONNECTOR – FIRED-ON WEDGE TAP, COPPER

Powder actuated (shoot-on) two-piece removable compression tap service connector. Copper body, for copper-to-copper connection. Compound filled and individually packaged.

CONDUCTOR RANGE			STD ITEM	SAP ITEM ID	PS ITEM ID
RUN	TAP	SHELL COLOR CODE			
500 Cu	4/0 Cu	Blue	S17R	9314168[Y]	0810926[Y]
4/0 CU	4/0 CU	Blue	S17S	9389969[Y]	
2/0 CU	2/0 CU	Blue	S17T	9389957[Y]	

SPLICE, AUTOMATIC - Cu, CCW, OR CW MESSENGER

Full-tension for Cu, CCW or CW messenger, copper body.

Copper

CONDUCTOR	STD ITEM	SAP ITEM ID	PS ITEM ID
#6 Sol. Cu.	S19A	9311550	3506305
#4 Sol. Cu.	S19B	9311549	3506306
#2 - #3 Sol., #3 Str.	S19BB	9313260	5968403
1/0 Sol., #1 Str., 3A CCW		9313259	5968405
2 Str. Cu., 4A CCW	S19C	9311548	3506307
2/0 Str. Cu.	S19D	9311547	3506308
4/0 Str. Cu.	S19E	9311554	3506309
6A CCW., #4 Str. Cu.	S19G	9311640	3506333
1/0 Str. Cu.	S19I	9311564	3506319

SPLICE, AUTOMATIC - Al OR ACSR CONDUCTORS

Full-tension for stranded aluminum or ACSR conductors. Aluminum body pre-filled (inhibitor loaded) and capped. Color coded end guides included for easy identification. ANSI C119.4; Class A, Class 1.

Aluminum & ACSR

LENGTH	COLOR CODE	CONDUCTOR	STD ITEM	SAP ITEM ID	PS ITEM ID
12” – 14”	Orange / Red	#4 ACSR, #2 ACSR	S19J	9314903	0810500
16”	Yellow	1/0 ACSR	S19K	9311566	3506321
		1/0 – 3/4, 1/0 – 4/3 AWAC (Spacer Cable)	S19L	9313755	5969624
-		#2/0 - #3/0 SAL & ACSR	S19N	9312560	3507324
16”	Pink / Black	4/0 ACSR, AAC, AAAC	S19S	9312756	5968612
18”	Green	336.4 SAL & ACSR	S19M	9311642	3506323
21.64”	Aqua	477.0 ECA	S19T	9313284	5968606

SPLICE, AUTOMATIC - STEEL AND ALUMOWELD GUY STRAND

Full-tension splice for steel and alumoweld guy strand. Aluminum body pre-filled and individually packaged.

Steel and Alumoweld

GUY STRAND	STD ITEM	SAP ITEM ID	PS ITEM ID
5/16” 6M Galvanized steel	S19P	9314616	0810876
⅜” 10M Galvanized steel or 12.5M Alumoweld	S19Q	9314615	0810877
7/16” (16M) G.S. or CW	S19R	9311641	3506324

<u>NOTE</u>: Do not use “Automatic” connectors for non-tension applications.

SPLICE, AUTOMATIC - MESSENGER

For spacer cable and copper aerial cable messenger applications.

CONDUCTOR	STD ITEM	SAP ITEM ID	PS ITEM ID
⅜ CW, 7 Str.	S19U	9313288	5968510
½ CW, 7 Str.	S19V	9313287	5968515

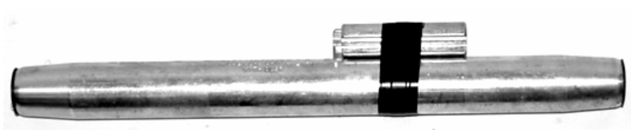
SPLICE, STANDARD COMPRESSION

One piece, full-tension splice connectors for **<u>ACSR conductors and AAAC conductors</u>**. Seamless aluminum with center stop, pre-filled and capped. ANSI C119.4; Class A, Class 1.

CONDUCTOR	LENGTH	DIE	STD ITEM	SAP ITEM ID	PS ITEM ID
#4 ACSR (6/1 & 7/1)	12”	BG, 243	S20B	9316664	2014307
#2 ACSR (6/1)	10¼”-12¼”	BG, 243	S20C1	9316639^{Y}	2014329^{Y}
#2 ACSR to #1/0 ACSR	13”	167, 702	S20D1	9316638^{Y}	2014330^{Y}
1/0 ACSR (6/1), AAAC 6201	13”-14¾”	167, 702	S20D2	9316636	2014332
1/0 AWG, 2/5 AWAC	15⅛”	679, 726	S20D3	9313754^{E}	5969625^{E}
2/0 AWAC (5/2)	15”	679, 726	S20E	9316635^{Y}	2014337^{Y}
4/0 ACSR, 6201, ECA		12A, 13A	S20H	9313752	5969705
336.4 ACSR (18/1)	19”	655	S20G	9316637^{Y}	2014331^{Y}

SPLICE, STANDARD COMPRESSION

Two piece, full-tension splice connectors for **ACSR conductors**.



CONDUCTOR	LENGTH	DIE	STD ITEM	SAP ITEM ID	PS ITEM ID
336.4 ACSR (26/7)		08 CD-60	S20R1	9315286	0803393
477.0 ACSR (26/7)		10 CD-60	S20R2	9312853	5969010
795.0 ACSR (54/7)		12 CD-60	S20R3	9312759[E]	5969165[E]
1113.0 ACSR (54/19)		14 CD-60	S20R4	9315760[E]	3506596[E]

SPLICE, STANDARD COMPRESSION

One piece, full-tension splice connectors for **aluminum conductors**. Seamless aluminum with center stop, pre-filled and capped. ANSI C119.4; Class A, Class 1.

CONDUCTOR	LENGTH	DIE	STD ITEM	SAP ITEM ID	PS ITEM ID
#4 Sol. Aluminum	2¾"	162/P, P	S21C1	9315979[Y]	3506569[Y]
3/0 AWG, 6201, 7 Str.		(658) or 1LA	S21D	9313012[E]	5969420[E]
4/0 7 or 19 Str. AAC	8¼" – 10½"	249	S21A	9311468	3506505
336.4 19 Str ACSR.		13A	S21E	9315874	5968967
336.4 19 Str. AAC	10"	321	S21B1		3506570
394.5, 6201, 19 Str AAC.		(642),13A	S21F	9313771[E]	5969807[E]
636.0, 37 Str.AAC		(125H) or 125, 10 CD	S21G	9312839	5968973
795.0, 37 Str.AAC		(140H) or 140, 11 CD	S21H	9312838	5968975
900.0, 37 Str. AAC		(150H) or 150, 12 CD	S21J	9312837[E]	5968977[E]
1113.0, 61 Str. AAC		13 CD	S21K	9312836[E]	5968980[E]
477 19str. AAC			S21L	9311473	3506472
556.4 19str. AAC		261, U261	S21M	9315766	3506575

SPLICE, STANDARD COMPRESSION

One piece, partial-tension service drop splice connectors for **aluminum or ACSR conductors**. Seamless aluminum with center stop, pre-filled and capped. ANSI C119.4; Class A, Class 2.

CONDUCTOR	LENGTH	DIE	STD ITEM	SAP ITEM ID	PS ITEM ID
#4 Str. Alum. or ACSR	4⅛"	BG	S22H	9313772	5969825
#4 Str. Alum. or ACSR to #2 Str. AAAC Reducer	4¼"	BG, 243	S22G	9314413	0811137
#2 AAAC Al or ACSR	5"	BG, 243, 239	S22F	9311470	3506490
#1/0 ACSR (6/1)	6¼"	247, 702	S22F1	9311498^{Y}	3506527^{Y}
336.4 Alum. or ACSR (18/1)	5¼"	655	S22E	9315849^{Y}	3506807^{Y}

SPLICE, STANDARD COMPRESSION

One piece, full-tension splice connectors for **Copper and CCW conductors**. Seamless copper with center conductor stop.

CONDUCTOR	LENGTH	DIE	STD ITEM	SAP ITEM ID	PS ITEM ID
#8 Solid Cu.	2" – 2½"	161/J, J	S23A	9316694^{Y}	2014149^{Y}
#6 Solid Cu.	2¼"	161/J, J	S23B	9316657^{Y}	2014688^{Y}
#4 Solid Cu.	2¾"	162/P, P	S23C1	9315873	3506572
#4 Stranded Cu.	2¾"	162/P, P	S23E1	9315872^{Y}	3506573^{Y}
#2 Stranded Cu.	3" – 4"	163/X, X	S23F	9311471	3506517
#6A CCW (2/1)	5½"	162/P, P	S23G1	9315789^{Y}	3506574^{Y}
#4A CCW (2/1)	5¾" – 6¾"	163/X, X	S23H	9311499^{Y}	3506525^{Y}
#1/0 Stranded Cu.	5⅜" – 7¼"	165	S23K	9311481	3506518
#2/0 Stranded Cu.	6" – 7¼"	166	S23L	9312464	3506389
#3/0 Stranded Cu.	7"	167	S23M	9311482^{Y}	3506519^{Y}
#4/0 Stranded Cu.	7"	168	S23N	9312463	3506390

SPLICE, STANDARD COMPRESSION

One piece non-tension loop splice connectors for **copper conductors**. Seamless cooper with center conductor stop.

CONDUCTOR	LENGTH	DIE	STD ITEM	SAP ITEM ID	PS ITEM ID
#2/0 Str. Cu.	3⅜" – 4"	166	S24E	9311483[Y]	3506520[Y]
#4/0 Str. Cu.	3⅛" – 6"	168	S24G	9311500[Y]	3506522[Y]

SPLICE, STANDARD COMPRESSION

One piece non-tension loop splices for **aluminum conductors**. Seamless aluminum with center stop, prefilled and capped. ANSI C119.4, class A, class 3. For secondary phase conductors.

CONDUCTOR	LENGTH	DIE	STD ITEM	SAP ITEM ID	PS ITEM ID
#2 Str. Al	2½" – 3"	0, BG	S26C	9311725	2015200
#1/0 Str. Al	2½" – 3"	243, BG	S26D	9311724	2015201

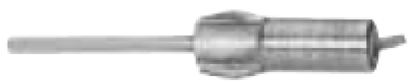
SPLICE, JUMPER LOOP, NON-TENSION

One piece non-tension loop splices for ACSR and AAC conductors. Seamless aluminum with center stop, prefilled and capped. ANSI C119.4, class A, class 3.

CONDUCTOR		DIE	STD ITEM	SAP ITEM ID	PS ITEM ID
ACSR	AAC				
336.4	336.4 - 350	13A	S26E	9312767	5969140
397.5	397.5 - 477	14A	S26F	9312765	5969143
477	500 - 556.6	15A	S26G	9312766	5969142
556.6	600 - 650	722	S26H	9312761	5969149
666.6	700 - 800	724	S26I	9312764	5969144
715.5 - 874.5	874.5 - 1000	725	S26J	9312763	5969146
954 - 1272	1192 - 1300	14CD	S26K	9312762	5969147
1510.5 - 1590	1700 - 1800	16CD	S26L	9313006	5969065
2167 - 2312	2250 - 2300	19CD	S26M	9312760	5969151

CONNECTOR – TERMINAL PLUG

Aluminum or tinned copper compression connector with a solid, smooth, tinned copper 6” plug 46 kV and below. Aluminum connectors shall be compound filled and capped. ANSI C119.4, Class A, Class 2 min.



	CABLE SIZE	D. (In.)	L. (In.)	CRIMPING TOOL / DIE / # OF CRIMPS: MD6 DIE	MD6 #/CR.	Y34A NEST	Y34 PR INDENT	Y35 OR Y39 DIE	Y35 OR Y39 #/CR.	STD ITEM	SAP ITEM ID	PS ITEM ID
COPPER	#2	.312	8	W162	4	A2CD	1	U2CRT	2	S27A	9313409[Y]	2015373[Y]
COPPER	#4/0	.460	8.7			A28D	1	U28RT	2	S27B	9313408[Y]	2015375[Y]
COPPER	500	.750	9.6			A34D	1	U34RT	4	S27C	9311801[Y]	2015376[Y]
COPPER	500*	.38	9.6			A34D	1	U34RT	4	S27C1	9313639[Y]	2015385[Y]
COPPER	* *For use with 200A cutouts and below.*											
ALUMINUM	#2	.312 - .324	8.7	W243	3	A243	3	U243	2	S27F	9313642	2015382
ALUMINUM	#1/0 Al. or ACSR	.312 - .364	9.75	BG WBG	8 4			UBG	4	S27H	9311799	2015380
ALUMINUM	336.4 – 350 Al or ACSR	.460 - .562	10.4					U655	3	S27J	9311798[Y]	2015381[Y]
ALUMINUM	500	.562	11					U34A RT	4	S27K	9313641[Y]	2015383[Y]
ALUMINUM	750	.87	11					U608 U786	6 5	S27L1	9308422[Y]	9202019[Y]
ALUMINUM	750	.750	12					U39A RT	4 DO NOT USE Y35 TOOL	S27L	9313640[Y]	2015384[Y]

NOTES:

1.) *In **Y45** tool use Y35 die with “S” adapter (Burndy Cat. No. PT-6515).*
2.) *In **Y46** tool use Y35 die with “P” adapter (Burndy Cat. No. P-UADP).*

SPLICE, COPPER AUTOMATIC REDUCING

Full tension copper automatic reducing connector for copper conductors. Splice provides full strength of the weaker of the two conductors and a resistance lower than the equivalent conductor.

CONDUCTOR		STD ITEM	SAP ITEM ID	PS ITEM ID
LARGE END	SMALL END			
#4 solid, #6 strand, #8A	#6 solid, #8 strand	S28A	9313256	5968415
#2 solid, #3 strand	#6 solid, #8 strand	S28B	9313255	5968420
#2 solid, #3-#4 strand	#4 solid, #6 strand	S28C	9313254	5968425
#1 solid, #2 strand	#2 solid, #3 strand	S28C1	9308134[E]	9201781[E]
1/0 solid, #1 strand	#2-#3 solid, #3 strand	S28D	9313253	5968440
2/0 solid, 1/0 strand, #2A	1/0 solid, #1 strand, 3A	S28E	9313252	5968460
3/0 solid, 2/0 strand	#2 solid, #3 strand	S28F	9313269	5968465
3/0 solid, 2/0 strand	1/0 solid, #1 strand	S28G	9313290	5968475
3/0 solid, 2/0 strand	2/0 solid, 1/0 strand, #2A	S28H	9313272	5968480
4/0 strand	3/0 solid, 2/0 strand	S28J	9313289	5968490

SPLICE, ALUMINUM AUTOMATIC REDUCING

Full tension automatic aluminum reducing splice for aluminum conductors. Splice provides full strength of the weaker of the two conductors and a resistance lower than the equivalent conductor.

CONDUCTOR		STD ITEM	SAP ITEM ID	PS ITEM ID
LARGE END	SMALL END			
477 Strand	336.4 Strand	S28K	9303020[E]	5968608[E]
1/0	#2 - #4	S28K1	9314337	0810147

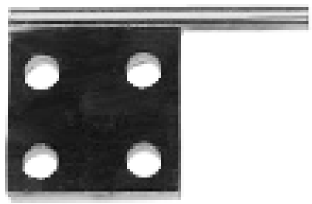
SPLICE, ALUMINUM COMPRESSION REDUCING

Non-tension aluminum compression reducing connector for aluminum conductors. These connectors are used to splice spacer cable.

CONDUCTOR		STD ITEM	SAP ITEM ID	PS ITEM ID
LARGE END	SMALL END			
4/0 AL	477.0 AL	S28L	9312754[E]	5968620[E]
477.0 AL	336.4 AL	S28M	9313010[E]	5969470[E]
556.5 AL	477.0 AL	S28N	9390879[E]	N/A

CONNECTOR, TERMINAL, FLAG STYLE

Tinned copper stud connector for hot line or grounding clamp connection at riser switch terminals. 1 ¾" standard NEMA hole spacing.



STD ITEM	SAP ITEM ID	PS ITEM ID
S30B	9313877	3504018

** Ampacity of 4/0 Cu. Is 360A @ 75° C, 405A @ 90° C.*

STAPLES, GALVANIZED STEEL

Galvanized, rolled diamond-point staples for wood poles. Per latest ANSI C135.14.

APPLICATION	LENGTH	INSIDE WIDTH	STD ITEM	SAP ITEM ID	PS ITEM ID
Anti-Theft		⅜"	S33A1	9388968	N/A
Ground Wire	1¾"	⅜"	S33A	9313388	3503451
Ground Wire Molding	2"	⅝"	S33B	9314525	0811201
1" Conduit	3"	1¹⁄₁₆"	S33C	9313387	3503453

KIT, GROUNDING ACCESSORIES - FOR FIBERGLASS POLES AND CROSSARMS

Includes 40 black nylon cable hangers (0.375 inch diameter), 10 black nylon cable hangers (0.75 inch diameter), and 50 1-inch #10 hex head mounting screws.

STD ITEM	SAP ITEM ID	PS ITEM ID
S34	9306205	9201848

KIT, ARMORED GROUND WIRE

18' of armored #4 AWG soft-drawn copper down ground wire with 4" prefinished ends and 36 cleated tamper resistant staples. For installation on wood poles. Use to replace stolen ground wires on distribution poles or for new ground wires in areas where ground wire theft has been a problem.

STD ITEM	SAP ITEM ID	PS ITEM ID
S35	9387556	N/A

STRAP, TRANSFORMER NEUTRAL/ARRESTER GROUND

Strap used to ground transformer secondary neutral bushing to the transformer tank. Can also be used to connect a transformer arrester ground to the transformer tank.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
0.04"x1.25'x9", 25/64 & 33/64 Holes	S40	9315697	9202614
0.04x1.25x12", two 33/64 Holes	S40B	9388936	------------

LINE SENSOR, POWER

A Medium Voltage Power Sensor that measures both Voltage and Current. It is attached directly to the primary voltage conductors of a Overhead Distribution or SubT lines (maximum 38kV) via a clamping action using a hotstick. Each sensor is capable of wireless communication with a paired data collector mounted on the utility pole. Collector box requires Radio Modem communications (Use R51C and R51C1) to communicate back to EMS. Units must be calibrated on the line before being put into service.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Line Power Sensor	SP1	9390510	N/A
Power Sensor Collector Box (Requires R51C & R51C1)	SP1A	9390512	N/A

TAPE, GENERAL PURPOSE FRICTION - BLACK

General purpose black friction tape for cable terminations and splices, consisting of a cotton fabric that has been thoroughly impregnated and evenly coated on both sides with a tacky adhesive insulating compound. ASTM D69.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
¾” X .015” X 82½’ Roll	T1A	9316053	2005503

TAPE, SEMICONDUCTING

High voltage electrical EPR based semi-conducting tape, furnished with a liner. Tape to be continuously imprinted with the word “conducting” or “semi-conducting”. Do not use on PILC cables.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
¾” X .030” X 15’ Roll	T1S	9316267	2005679

BRAID, GROUNDING

Flat tinned copper wire woven braid constructed of 240 strands of #30 AWG wire having a current carrying capacity equivalent to #6 AWG copper wire. To be furnished on labeled spools.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
½” X 15’ Roll	T1T5	9316288	2005681

TAPE, VINYL PLASTIC

General purpose electrical insulating tape consisting of a black elastomeric backing made from vinyl chloride plastic coated on one side with a pressure sensitive adhesive. Tape to be in accordance with the current A.S.T.M. Specification D 3005.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
¾" X .0085" X 66' Roll	T2W1	9316070	2005620
1½" X .0085" X 66' Roll	T2W2	9314120	0810652

TAPE, INSULATING

High voltage ozone, U.V. and weather resistant EPR rubber insulating electrical tape. Self-amalgamating, black.

LINER	DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
None	1" X 0.030" X 30' Roll	T5B	9316047	2005547
None	1½" X 0.030" X 30' Roll	T5B6	9316067	2005656

TAPE, PLASTIC SEALER

Plastic sealer compound tape, grey in color; furnished with a liner.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
4" X .125" X 10' Roll	T5D4	9316052[Y]	2005515[Y]

TAPE, ELECTRICAL FILLER

Moldable - Scotchfil

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
1.5" X .125" X 60" Roll	T5E	9310669[E]	5487015[E]

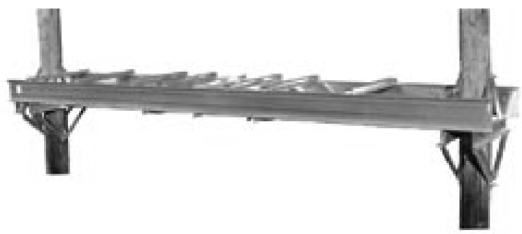
TAPE, SILICONE RUBBER

High voltage, weather and tracking resistant, non-contaminating, self-cleaning, terminating electrical tape. Light grey, non-adhesive self-amalgamating.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
1" X .020" X 30' Roll	T5S1	9316069	2005621

MOUNT, TRANSFORMER PLATFORM

Two-pole, assembled aluminum platform mount for mounting three 333 and 500kVA stepdown transformers and regulators weighing 2000 lbs. to 4500 lbs. each. Attaches with four 3/4" machine bolts (two in each pole). Includes tie down clips.



STD ITEM	SAP ITEM ID	PS ITEM ID
T6	9314028	3012522

BRACKET, TRANSFORMER OR REGULATOR TWO PIECE STEEL

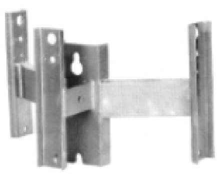
Two piece steel bracket 24" and 36" lug spacing for ANSI C57.12.20 type B and modified type C support lugs. For 250kVA transformers and 167kVA regulators. Two piece set includes (6) ¾" x 2" equipment mounting bolts. NOTE: Adapter plates (T10) are used to adapt/modify type C lugs on large transformers for single-bolt mounting.

Larger diameter poles may require additional band segments and so an additional steel bracket assembly may be needed.

STD ITEM	SAP ITEM ID	PS ITEM ID
T9AS	9314025	3012556

MOUNTS, TRANSFORMER CLUSTER – 3 PHASE

Heavy duty galvanized cluster mount brackets for banking transformers.



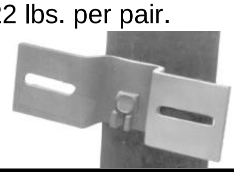
DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
SMALL Cluster For up to 3 x 25kVA, 500 lbs. per position. Includes (6) ⅝″ x 2″ equipment mounting bolts. * Use two ⅝″ thru bolts & 2-¼″ square washers.	T9C	9313179	5989815
MEDIUM Cluster For 3 x 37.5kVA to 3 x 100kVA, 2000 lbs. per position. Includes (6) ⅝″ x 2″ & (6) ¾″ x 2″ equipment mounting bolts. ** Use three ¾″ thru bolts** & 3″ curved washers.	T9D	9313178	5989820
LARGE Cluster For 3 x 167kVA to 3 x 333kVA, 3000 lbs. per position. Includes (6) ¾″ x 2″ equipment mounting bolts. **Use three ¾″ thru bolts & 3″ curved washers.	T9E	9313177	5989825

* *Pole drilling - two 11/16" holes spaced 12"*

** *Pole drilling - three 13/16" holes spaced 12"*

PLATES, TRANSFORMER ADAPTER – ONE PAIR

Heavy galvanized steel adapter plates for modifying ANSI Type C equipment lugs (i.e. transformers over 167KVA). Each plate is 4½" X 16" X ½" with a 3" 'offset'. Includes (2) ⅝" equipment mounting bolts. Approximately 22 lbs. per pair.



STD ITEM	SAP ITEM ID	PS ITEM ID
T10	9314026	3012553

WRAP, SPIRAL

Black PE outdoor spiral wrapping. To tie triplex conductor at ends and secondary breaks. ½" O.D.,50' roll.

STD ITEM	SAP ITEM ID	PS ITEM ID
T15	9315739	3506738

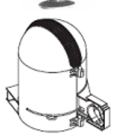
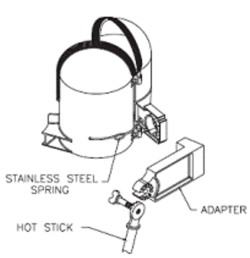
GUARD, ANIMAL – ELECTROSTATIC

Formerly the Guthrie Guard, without center nubs trimmed, one person operation

	STD ITEM	SAP ITEM ID	PS ITEM ID
	T21	9308137	9201775

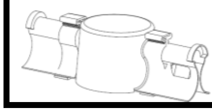
GUARD, ANIMAL - BUSHINGS

Primary bushing animal guards / covers for overhead line equipment. Light grey polypropylene, or equivalent, UV resistant, (1) piece hinged bushing covers retrofit to insulate energized bushings from animal contact. Install over the top bushing skirt.

	DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
	Hotstick application for transformer/terminator bushings	T22A	9314091	0810616
	Full profile for most transformers and #2 - 4/0 terminators	T22B	9314474	0811154
	Full profile for recloser/regulator and pot-head bushings.	T22C	9314397	0811157
	Short profile for arrester/capacitor bushings	T22D	9314398	0811156
	Full profile.	T22E	9314514	0811165
	Full profile, can be applied easily with hotstick or shotgun. Spring-loaded.	T22F	9307868	9202268
	Hotstick adapter for T22F	T22F1	9307813	9202281

GUARD, ANIMAL – LINE POST SENSOR

For installation on line post sensors. Covers are hot-stickable and snap onto the conductor.



STD ITEM	SAP ITEM ID	PS ITEM ID
T22M	9394100	N/A

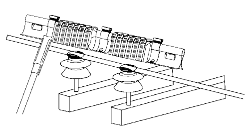
GUARD, ANIMAL - STINGER COVERS

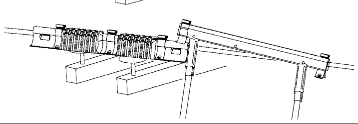
Stinger covers protect against phase to phase and phase to ground animal contacts. Can be installed without disconnecting leads/taps.

INSIDE DIAMETER (INCHES)	DIMENSION (FEET)	FLASHOVER TEST VOLTAGE	STD ITEM	SAP ITEM ID	PS ITEM ID
3/8	50 coil	13 kV	T23A	9314476	0811218
5/8	12 coil	18 kV	T23B	9314892	0811219
3/4	12 coil	20.5 kV	T23C	9314468	0811220

PROTECTOR, WILDLIFE

Protective cover for insulators and conductors - fits conductors #2 to 795 kcmil. Both items can be installed using a hotstick. 35kV maximum.

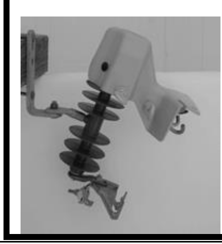




DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Fits over pin type insulators.	T40	9308366	9201765
Fits over conductors.	T43	9308367	9201767

GUARD, ANIMAL – POLYMER CUTOUTS

For installation on polymer cutouts, light grey polypropylene or equivalent, UV resistant, includes (1) 5½ inch snap fit pin and (1) 3½ inch snap fit pin, hotstickable.



STD ITEM	SAP ITEM ID	PS ITEM ID
T45	9306197	9201856

TRANSFORMER, SINGLE – PHASE POLE TYPE

Oil filled overhead conventional transformers for primary distribution circuits per NG MS2523 (Physical Data Codes beginning with “10”) & MS2526 - Stainless Steel tanks (Physical Data Codes beginning with “11).

PHYSICAL DATA CODE	PRIMARY VOLTAGE	SECONDARY	KVA	STD ITEM	SAP ITEM ID	PS ITEM ID (see Note)
10-109-10-00-00 (OH-PRI-SEC-TAPS-FUSE)	2400 / 4160Y	120 / 240	10	T91AA	9301141	0110103
			25		9300853	0125103
			50		9301186	0150103
			75		9301215	0175103
			100		9301201	0176103
10-109-10-22-00	2400/4160Y Taps 2-2½ % above, 2-2½% below	120/240	250	T91AA1	9300722[E]	5411130[E]
10-109-33-22-00	2400 / 4160Y Taps 2-2½% above, 2-2½% below	277 / 480Y	50	T91AB	9301189[Y]	0150185[Y]
			75		9301223[Y]	0175185[Y]
			100		9301202[Y]	0176185[Y]
			167		9300898[Y]	0178185[Y]
10-258-10-00-00	2400 / 4160Y X 7200 / 12470Y	120 / 240	25	T91AC	9300529[E]	5417164[E]
			50		9300530[E]	5417166[E]
			100		9300531[E]	5417170[E]
10-259-10-00-00	2400 / 4160Y X 7620 / 13200Y	120 / 240	10	T91AD	9301142	0110501
			25		9301161	0125501
			50		9301104	0150501
			75		9301218[Y]	0175501[Y]
			100		9300856	0176501
			167		9300903[Y]	0178501[Y]
10-259-33-00-00	2400 / 4160Y X 7620 / 13200Y	277 / 480Y	25	T91AE	9301095	0125552
			50		9301119	0150552
			75		9301205[Y]	0175552[Y]
			100		9300940[Y]	0176552[Y]
			167		9301012[Y]	0178552[Y]
			333		9300844[Y]	0184552[Y]
10-260-10-00-00	2400 / 4160Y X 7970 / 13800Y	120 / 240	10	T91AF	9300799[E]	5417500[E]
			25		9300535[E]	5417520[E]
			50		9300536[E]	5417530[E]
			100		9300537[E]	5417540[E]
			167		9300774[E]	5417543[E]
			250		9300747[E]	5417545[E]
10-315-10-00-00	4160 GrdY / 2400 X 12470 GrdY / 7200	120 / 240	10	T91AG	9300600[E]	5418010[E]
			25		9300601[E]	5418030[E]
			50		9300602[E]	5418040[E]
			100		9300603	5418050
10-316-10-00-00	4160 GrdY / 2400 X 13200 GrdY / 7620	120 / 240	10	T91AH	9300606[E]	5418100[E]
			25		9300617	5418120
			50		9300572	5418130
			100		9300573[E]	5418140[E]
10-317-10-00-00	4160 GrdY / 2400 X 13800 GrdY / 7970	120 / 240	10	T91AJ	9300778[E]	5418270[E]
			25		9300574[E]	5418290[E]
			50		9300575[E]	5418300[E]
			100		9300355[E]	5418320[E]
11-317-10-00-00 [Stainless Steel]	4160 GrdY/2400 X 13800 GrdY/7970	120/240	25	T91AJS	9300369[E]	9201577[E]
			50		9300373[E]	9201580[E]
10-310-10-00-00	3740 GrdY / 2160 X 13200 GrdY / 7620	120/240	10	T91AK	9300596[E]	5417970[E]
			25		9300597[E]	5417990[E]
			50		9300598[E]	5418000[E]

TRANSFORMER, SINGLE – PHASE POLE TYPE (CONTINUED)

Oil filled overhead conventional transformers for primary distribution circuits per NG MS2523 (Physical Data Codes beginning with "10") & MS2526 - Stainless Steel tanks (Physical Data Codes beginning with "11).

PHYSICAL DATA CODE	PRIMARY VOLTAGE	SECONDARY	KVA	STD ITEM	SAP ITEM ID	PS ITEM ID (see Note)
10-310-33-00-00	3740 GrdY / 2160 X 13200 GrdY / 7620	277 / 480	50	T91AL	9300599[E]	5418005[E]
10-273-10-00-00	4800 / 8320Y X 7620 / 13200Y	120 / 240	10	T91BA	9301143	0110504
			25		9301160	0125504
			50		9301185	0150504
			75		9301219	0175504
			100		9301232	0176504
			167		9300904[Y]	0178504[Y]
10-273-33-00-00	4800 / 8320Y X 7620 / 13200Y	277 / 480Y	25	T91BB	9301094[Y]	0125553[Y]
			50		9301123	0150553
			75		9301194[Y]	0175553[Y]
			100		9300941[Y]	0176553[Y]
			167		9301011[Y]	0178553[Y]
10-275-10-00-00 (OH-PRI-SEC-TAPS-FUSE)	4800 / 8320Y X 7970 / 13800Y	120 / 240	10	T91BC	9300695[E]	5417830[E]
			25		9300568[E]	5417850[E]
			50		9300595[E]	5417860[E]
10-118-10-00-00	7200 / 12470Y	120 / 240	25	T91CA	9300546[E]	5412640[E]
			50		9300668[E]	5412650[E]
			75		9300694[E]	5412695 [E]
			100		9300547[E]	5412658 [E]
			167		9300657[E]	5412660 [E]
			250		9300684[E]	5412663 [E]
10-165-10-00-00	12470GrdY / 7200	120 / 240	10	T91CB	9300464	5415980
			25		9300565	5416000
			50		9300555	5416010
11-165-10-00-00 [Stainless Steel]	12470GrdY / 7200	120 / 240	25	T91CBS	9300370[E]	9201578[E]
			50		9300371[E]	9201579[E]
10-165-33-00-00	12470 GrdY / 7200	277 / 480Y	25	T91CBA	9300463[E]	5416031[E]
			50		9300518[E]	5416032[E]
			100		9300462[E]	5416033[E]
			167		9300449[E]	5416040 [E]
10-119-10-00-00	7620 / 13200Y	120 / 240	10	T91DA	9301145	0110515
			25		9301131	0125515
			50		9300854	0150515
			75		9301206	0175515
			100		9300938	0176515
			167		9300908[Y]	0178515[Y]
10-119-10-14-00	7620 / 13200 Taps 4 @ 2½% below	120 / 240	10	T91DB	9301173[Y]	0110544[Y]
			25		9301096[Y]	0125544[Y]
			50		9301118[Y]	0150544[Y]
10-119-23-22-00	7620/13200Y Taps 2-2½% above, 2-2½% below	292 x 584	50	T91DB1	9300203[E]	5413565[E]
			100		9300691[E]	5413470[E]
			167		9300688[E]	5413480[E]
			500		9300687[E]	5413482[E]
10-119-33-22-00	7620 / 13200Y Taps 2-2½% above, 2-2½% below	277 / 480Y	50	T91DC	9301126[Y]	0150554[Y]
			75		9301187[Y]	0175554[Y]
			100		9300942[Y]	0176554[Y]
			167		9300955[Y]	0178554[Y]
10-119-12-22-00	7620 / 13200Y Taps 2-2½% above, 2-	240/480	25	T91DD	9300693[E]	5413390[E]
			500		9300692[E]	5413430[E]

	2½% below					
10-167-10-00-00	13200 GrdY / 7620	120 / 240	10	T91DE	9301144	0110511
			25		9301159	0125511
			50		9301110	0150511
			75		9301221	0175511
			100		9300430	5416130
			250		9301006[Y]	0182511[Y]

TRANSFORMER, SINGLE – PHASE POLE TYPE (CONTINUED)

Oil filled overhead conventional transformers for primary distribution circuits per NG MS2523 (Physical Data Codes beginning with “10”) & MS2526 - Stainless Steel tanks (Physical Data Codes beginning with “11).

PHYSICAL DATA CODE	PRIMARY VOLTAGE	SECONDARY	KVA	STD ITEM	SAP ITEM ID	PS ITEM ID (see Note)
10-167-33-00-00	13200 GrdY / 7620	277 / 480Y	25	T91DEA	9300521	5416297
			50		9300522	5416300
			100		9300503	5416310
			167		9300513	5416320
10-264-10-00-00	4160 / 7200Y X 7620/13200Y	120 / 240	25	T91DF	9301170[Y]	0125536[Y]
			50		9301112[Y]	0150536[Y]
			75		9301214[Y]	0175536[Y]
10-120-10-00-00	7970 / 13800Y	120 / 240	15	T91EA		5413750[E]
			25		9300108[E]	5413760[E]
			50		9300107[E]	5413770[E]
			100		9300106[E]	5413790[E]
10-120-33-00-00	7970/13800Y	277/480Y	333	T91EA3	9300178[E]	5414043[E]
			500		9300103[E]	5414044[E]
10-120-23-22-00	7970 / 13800Y Taps 2-2½% above, 2-2½% below	292 x 584	25	T91EA4	9300551[E]	5413990[E]
			50		9300552[E]	5414000[E]
			100		9300554[E]	5414010[E]
10-120-14-22-00	7970 / 13800Y Taps 2-2½% above, 2-2½% below	292 / 584	250	T91EA5	9300026[E]	5413939[E]
10-169-10-00-00	13800GrdY / 7970	120 / 240	10	T91EB	9300524[E]	5416500[E]
			25		9300525[E]	5416520[E]
			50		9300526[E]	5416540[E]
			100		9300500[E]	5416550[E]
			250		9300499[E]	5416552[E]
10-169-33-00-00	13800GrdY / 7970	277 / 480Y	25	T91EBA	9300528[E]	5416638[E]
			50		9300485[E]	5416640[E]
			100		9300484[E]	5416650[E]
10-010-10-22-00	11500 Taps 2-2½% above, 2-2½% below	120 / 240	100	T91EC	9300749[E]	5410003[E]
10-010-23-22-00	11500 Taps 2-2½% above, 2-2½% below	292 X 584	250	T91ED	9300527[E]	5410007[E]
10-109-12-00-00	2400 / 4160Y	240 / 480	25	T91EE	9300723[E]	5411230[E]
			50		9300543[E]	5411240[E]
10-109-23-22-00	2400 / 4160Y Taps 2-2½% above, 2-2½% below	292 x 584	25	T91EF	9300796[E]	5411540[E]
			100		9300795[E]	5411560[E]
			167		9300822[E]	5411570[E]
10-109-33-00-00	2400 / 4160Y	277 / 480Y	50	T91EG	9300545	5411665
			100		9300821[E]	5411670[E]
10-114-12-00-00	4800 / 8320Y	240 / 480	10	T91EH	9300321	5412280
10-011-10-14-00	12000 Taps 4 - 2½ % below	120 / 240	10	T91F	9301172[Y]	0110643[Y]
			25		9301235[Y]	0125643[Y]
			50		9301100[Y]	0150643[Y]
			75		9301200[Y]	0175643[Y]
10-014-10-14-00	13200 Taps 4 - 2½ % below	120 / 240	25	T91G	9301244[Y]	0125743[Y]

10-131-10-87-00	13800/23900Y Taps 14400/14100/ 13800/13500/13200	120 / 240	25	T91G2	9300049E	5414675E
			167		9300021E	5414690E
10-131-12-87-00	13800/23900Y Taps 14400/14100/ 13800/13500/13200	240 / 480	250	T91G3	9300018E	5414760E
			500		9300017E	5414763E

TRANSFORMER, SINGLE – PHASE POLE TYPE (CONTINUED)

Oil filled overhead conventional transformers for primary distribution circuits per NG MS2523 (Physical Data Codes beginning with "10") & MS2526 - Stainless Steel tanks (Physical Data Codes beginning with "11).

PHYSICAL DATA CODE	PRIMARY VOLTAGE	SECONDARY	KVA	STD ITEM	SAP ITEM ID	PS ITEM ID (see Note)
10-131-23-22-00	13800 / 23900Y Taps 2-2½% above, 2-2½% below	292 x 584	333	T91G4	9300016[E]	5414835[E]
			500		9300031[E]	5414840[E]
10-131-23-87-00	13800/23900Y Taps 14400/14100/ 13800/13500/13200	292 x 584	25	T91G5	9300332[E]	5414910[E]
10-131-12-22-00	13800 / 23900Y Taps 2-2½% above, 2-2½% below	240 / 480	167	T91G6	9300020[E]	5414720[E]
10-015-10-92-00	22900 Taps 24100/23500/ 22900/22300/21700 NON-PRECAP – TRANSMISSION CLASS PROJECTS ONLY	120 / 240	10	T91GG	9390995	N/A
10-015-10-92-00	22900 Taps 24100/23500/ 22900/22300/21700	120 / 240	10	T91GG	9300819	5410210
			25		9300517[E]	5410220[E]
			50		9300818	5410212
			100		9300817[E]	5410230[E]
			500		9300816[E]	5410233[E]
10-015-33-92-00	22900 Taps 24100/23500/22900/ 22300/21700	277 / 480Y	50	T91GG2	9300810[E]	5410324[E]
			167		9300809[E]	5410327[E]
10-015-23-92-00	22900 Taps 24100/23500/22900/ 22300/21700	292 x 584	333	T91GG4	9300814[E]	5410263[E]
10-177-10-84-00	24940GrdY/14400 Taps 14400/ 13800/13200/ 12870/12450	120 / 240	10	T91GJ	9300728[E]	5416792[E]
			25		9300727[E]	5416795[E]
			50		9300726[E]	5416796[E]
10-017-10-22-00	34400 Taps 2-2½% above, 2-2½% below NON-PRECAP – TRANSMISSION CLASS PROJECTS ONLY	120 / 240	10	T91HA	9390285	N/A
10-017-10-22-00	34400 Taps 2-2½% above, 2-2½% below	120 / 240	10	T91HA	9301166	0110935
			25		9301238[Y]	0125935[Y]
			50		9301211[Y]	0150935[Y]
10-180-10-00-00	34500 GrdY / 19920	120 / 240	25	T91HC	9301237	0125922
			50		9300539	5416841
			100		9300725	5416843
10-180-33-00-00	34500 GrdY / 19920	277 / 480Y	25	T91HD	9300724[E]	5416845[E]
			50		9300734[E]	5416848[E]
10-118-12-00-00	7200 / 12470Y	240 / 480	25	T91HE	9300683[E]	5412730[E]
			50		9300681[E]	5412740[E]
			100		9300680[E]	5412750[E]
			167		9300679[E]	5412760[E]
			250		9300415[E]	5415678[E]
10-133-23-84-00	14400 / 24940Y Taps 2-2½% above, 2-2½% below	292 x 584	167	T91HE1	9300416[E]	5415677[E]
10-275-12-00-00	4800 / 8320Y X 7970 / 13800Y	240 / 480	50	T91HE3	9300663[E]	5417890[E]
10-118-23-22-00	7200 / 12470Y Taps 2-2½% above, 2-2½% below	292 x 584	25	T91HF	9300706[E]	5412800[E]
			50		9300548[E]	5412810[E]
			100		9300705[E]	5412820[E]
			167		9300549[E]	5412830[E]

TRANSFORMER, SINGLE – PHASE POLE TYPE (CONTINUED)

Oil filled overhead conventional transformers for primary distribution circuits per NG MS2523 (Physical Data Codes beginning
(Physical Data Codes beginning with "11).

PHYSICAL DATA CODE	PRIMARY VOLTAGE	SECONDARY				
10-315-33-00-00	4160 GrdY / 2400 X 12470 GrdY / 7200	277 / 480Y	25	T91HF1	9300660[E]	5418059[E]
			50		9300604[E]	5418060[E]
			100		9300784[E]	5418070[E]
10-316-33-00-00	4160 GrdY / 2400 X 13200 GrdY / 7620	277 / 480Y				
10-317-33-00-00	4160 GrdY / 2400 X 13800 GrdY / 7970	277 / 480Y				
10-330-10-00-00	12470 GrdY / 7200 X 34500 GrdY / 19920	120 / 240				
10-331-10-00-00	13200 GrdY / 7620 X 34500 GrdY / 19920	120 / 240				
10-119-10-22-00	7620 / 13200Y Taps 2-2½% above, 2-2½% below	120 / 240				
10-165-33-22-00	12470 GrdY / 7200 Taps 2-2½% above, 2-2½% below	277 / 480Y				
10-133-10-22-00	14400 / 24940Y Taps 2-2½% above, 2-2½% below	120 / 240				
10-167-10-22-00	13200 GrdY / 7620 Taps 2-2½% above, 2-2½% below	120 / 240				
10-258-23-22-00	2400 / 4160Y X 7200 / 12470Y Taps 2-2½% above, 2-2½% below	292 x 584				
10-258-33-00-00	2400 / 4160Y X 7200 / 12470Y	277 / 480Y				
10-260-07-00-00	2400 / 4160Y X 7970 / 13800Y	600				
10-260-12-00-00	2400 / 4160Y X 7970 / 13800Y	240 / 480				
10-260-12-22-00	2400 / 4160Y X 7970 / 13800Y Taps 2-2½% above, 2-2½% below	240 / 480				
10-260-23-22-00	2400 / 4160Y X 7970 / 13800Y Taps 2-2½% above, 2-2½% below	292 x 584				

TRANSFORMER, SINGLE – PHASE POLE TYPE (CONTINUED)

Oil filled overhead conventional transformers for primary distribution circuits per NG MS2523 (Physical Data Codes beginning with “10”) & MS2526 - Stainless Steel tanks (Physical Data Codes beginning with “11”).

PHYSICAL DATA CODE	PRIMARY VOLTAGE	SECONDARY	KVA	STD ITEM	SAP ITEM ID	PS ITEM ID (see Note)
10-260-33-00-00	2400 / 4160Y X 7970 / 13800Y	277 / 480Y	25	T91HN5	9300746^{E}	5417583^{E}
			50		9300567^{E}	5417585^{E}
			100		9300786^{E}	5417587^{E}
10-265-10-00-00	4160 / 7200Y X 7970 / 13800Y	120 / 240	10	T91HN6	9300650^{E}	5417645^{E}
			25		9300649^{E}	5417646^{E}
11-167-10-00-00 [Stainless Steel]	13200 GrdY / 7620	120 / 240	10	T91HPS	9300433^{E}	5416085 ^{E}
			25		9300432^{E}	5416105 ^{E}
			50		9300431^{E}	5416125 ^{E}
			75		9300409^{E}	5416128 ^{E}
			100		9300519^{E}	5416135 ^{E}
			167		9300520^{E}	5416142 ^{E}
11-169-10-00-00 [Stainless Steel]	13800 GrdY / 7970	120 / 240	25	T91HQS	9300367^{E}	9201575 ^{E}
			50		9300368^{E}	9201576 ^{E}

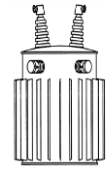
AUTOTRANSFORMERS, SINGLE-PHASE POLE TYPE

Oil filled overhead autotransformers for primary distribution circuits per PPL MS2528 (Physical Data Codes beginning with “20”).

PHYSICAL DATA CODE	PRIMARY VOLTAGE	SECONDARY	KVA	STD ITEM	SAP ITEM ID	PS ITEM ID (see Note)
20-120-38-00-00	7970 / 13800Y No Taps	7620 / 13200Y	2,500	T91HR1	9300891^{E}	5421948^{E}

Note: For transformers, an ITEM ID with an “**E**” superscript at the end of the number means this transformer is used only in Rhode Island. An ITEM ID with a “**Y**” superscript at the end of the number means this transformer was formerly used in other jurisdictions outside of Rhode Island and should no longer be used. An ITEM ID with no superscript at the end of the number means this transformer is used throughout the PPL system.

TRANSFORMER, SINGLE PHASE 'STEP-UP / STEP-DOWN'



Oil filled pole type conventional ratio transformers for step-up or step-down applications on overhead primary distribution circuits per MS2541.

PHYSICAL DATA CODE	PRIMARY VOLTAGE (HV)	SECONDARY VOLTAGE (LV)	KVA	STD ITEM	SAP ITEM ID	PS ITEM ID
10-118-35-00-00 (OH-PRI-SEC-TAPS-FUSE)	7200 / 12470Y	2400 / 4160Y	50	T91J	9300699[E]	5412875[E]
			100		9300351	5412880
			167		9300698	5412890
			250		9300671	5412900

10-118-35-22-00			50	T91J1	93006700	5412930
			500		93006699	5412965
			750		93001005	5412967
			1667		93001004	5412975
10-119-35-00-00	7620 / 13200Y	2400 / 4160Y	100	T91K	93006868E	5413530E
			167		**93009998**	0178578E
			250		93006985E	5413542E
			333		93001992E	5413567E
10-116-36-04-00	6930 / 12000Y	4800 /	250	T91KK	93000023	9201876

MATERIAL DESCRIPTION

Business Use

		8320Y			3	
10-119-34-00-00	7620 / 13200Y	4160 / 7200Y	50	T91L	9301127[Y]	0150579[Y]
			75		9300066[Y]	0175579[Y]
			100		9300943[Y]	0176579[Y]
			167		9300999[Y]	0178579[Y]
			250		9300953[Y]	0182579[Y]
10-119-36-00-00	7620 / 13200Y	4800 / 8320Y	50	T91M		5413608[E]
			100		9300189[E]	5413610[E]
			167		93001	5413620[E]

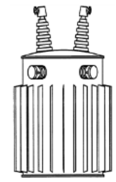
					88[E]	
			50		9301111[Y]	0150513[Y]
			75		9301222	0175513
			100		9301234	0176513
10-119-44-00-00	7620 / 13200Y	2400 / 4160Y4800 / 8320Y	167	T91N	9300907	0178513
			250		9301007	0182513
			333		9300846[Y]	0184513[Y]
			500		9300951	0185513
10-120-35-00-00	7970 / 13800Y	2400 /	50	T91P	9300337	9201040[E]

		4160Y			E	
			100		9300176E	5414060[E]
			167			5414070[E]
10-120-35-22-00	7970/13800Y Taps 2-2½% above, 2-2½% below	2400/4160Y	50	T91PP	9300175E	5414120[E]
			100		9300174E	5414130[E]
			167		9300173E	5414140[E]
			333		9300172E	5414150[E]
			500		9300171E	5414151[E]
10-120-36-00-00	7970 / 13800Y	4800 / 83	100	T91Q	9300197E	5414170[E]
			1		9	5414180[E]

		20Y	67		3001969E	
10-126-36-04-00	12000 / 20785Y	4800 / 8320Y	250	T91QQ	9300232Y	9201875Y
10-017-38-00-00	34400	7620/13200Y	500	T91R	9301091Y	0185930Y
10-140-35-00-00	19920/34500Y	2400 / 4160Y	50	T91S	9300481E	5415958E
			100		9300479E	5415961E
				167	9300470E	5415971E
				333	9300472E	5415968E
			500		9300494E	5415973E

TRANSFORMER, SINGLE PHASE 'STEP-UP / STEP-DOWN'

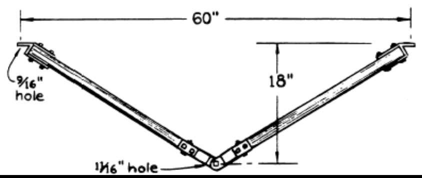
Oil filled pole type conventional ratio transformers for step-up or step-down applications on overhead primary distribution circuits per MS2541.



PHYSICAL DATA CODE	PRIMARY VOLTAGE (HV)	SECONDARY VOLTAGE (LV)	KVA	STD ITEM	SAP ITEM ID	PS ITEM ID
10-169-35-22-00	13800 GRDY/7970 Taps 2-2½% above, 2-2½% below	2400 / 4160Y	50	T91T	9300730[E]	5416699[E]
			250		9300731[E]	5416697[E]
			333		9300172[E]	5414150[E]
			500		9300171[E]	5414151[E]
10-114-35-00-00	4800/8320Y	2400 / 4160Y	75	T91W	9301217	0175371
			167		9300901	0178371
			500		9300949	0185371

BRACE, WOOD CROSSARM PAIR

Pentachlorophenol treated wood transmission crossarm braces with galvanized steel end fittings. One pair 'reversible' braces provide 60/72" spread and 18/22" drop.



SPREAD	DROP	STD ITEM	SAP ITEM ID	PS ITEM ID
60"	18"	TB60	9311873	3502879
72"	22"	TB60E	9311783	3502685

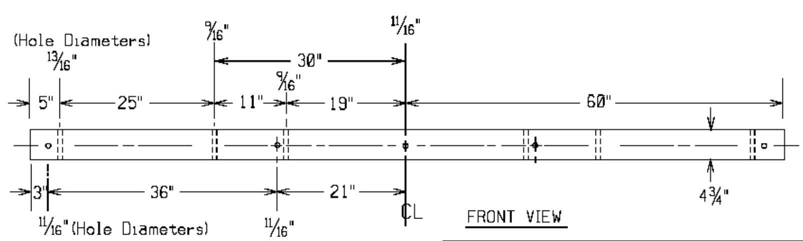
BRACE, WOOD CROSSARM

Wood X-, with center clamp, 2 ¾" X 3 ½", 6' – 6" spacing. For distribution supply installations.

STD ITEM	SAP ITEM ID	PS ITEM ID
TB60C	9310815	5105648[E]

CROSSARM, 4 PIN HIGH TENSION

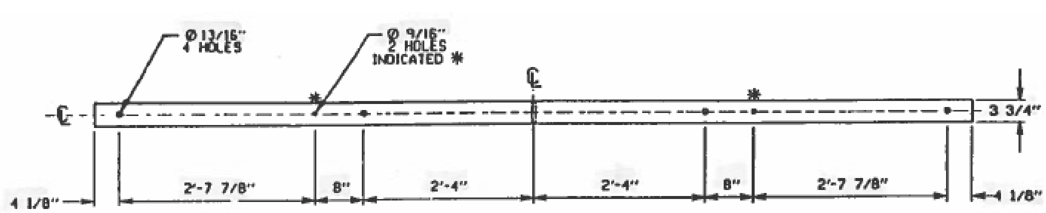
3 ¾" X 4 ¾" X 10' Douglas Fir, pentachlorophenol treated per latest MS 2121.



STD ITEM	SAP ITEM ID	PS ITEM ID
TC10	9312031	3502602

CROSSARM, 4 PIN HIGH TENSION

3 ¾" X 4 ¾" X 12' Douglas Fir, pentachlorophenol treated per latest MS 2121.



STD ITEM	SAP ITEM ID	PS ITEM ID
TC12	9312026	3502619

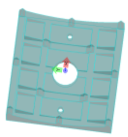
CROSSARM, ASSEMBLY

Two (2) transmission Douglas Fir crossarms. $3^{5}/_{8}$“ x 7½” x 18’. Pentachlorophenol treated per PPL E-1099 Spec. All associated mounting and assembly hardware included. For use when constructing an equipment platform.

STD ITEM	SAP ITEM ID	PS ITEM ID
TC20	9312027	3502618

PLATE, GRID

Single curve, spiked one side only. 41/8” x 41/8” with 15/16” diameter hole. Hot dip galvanized, malleable iron.



STD ITEM	SAP ITEM ID	PS ITEM ID
TC22	9311891	3502248

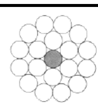
CONNECTOR, GROUND

Cable to flat grounding connector for #4 solid through #2/0 stranded Cu. conductors to ¼” thick flat surface. Cast copper body with silicon bronze bolt, nut and lock washer.

STD ITEM	SAP ITEM ID	PS ITEM ID
TC27	9316301	2007822

CABLE, BARE - PRIMARY LINE WIRE, 15kV

For employment of 3000lb maximum design tension installations.

SIZE		KIND	COVERING	QUANTITY	STD ITEM	SAP ITEM ID	PS ITEM ID
336.4 kcmil		Single conductor-18/1 Str. (ACSR) Standard 3 Phase Primary Conductor	Bare MERLIN	3795’ N.R. Reel (365lb/1000ft.)	TC52	9315752	4035236

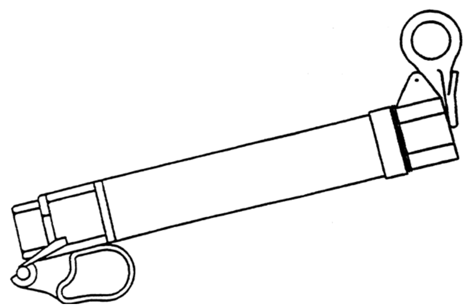
CLAMP, POST INSULATING

Clamps for use with both upright and horizontally mounted clamp top line post insulators (I13B, I13D). Clamps are mounted on a metal cap cemented to the top of the line post insulator.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
0.35” – 0.84” Conductors, aluminum	TC80A	9311563	3506444
1.0” – 1.5” Conductors, aluminum	TC80B	9312462	3504636

POWER FUSE - HOLDER

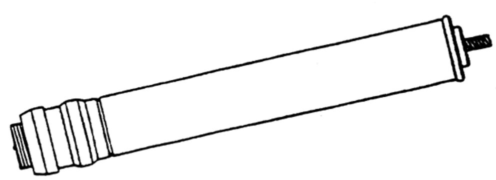
S & C type SM-5, outdoor power fuse holder for use with S & C type SM-5 power fuse, item TF3 and S & C type SM-5 power fuse mounting, item TS2.



STD ITEM	VOLTAGE	BIL	TYPE	MAX RATING		SAP ITEM ID	PS ITEM ID
				CONTINUOUS CURRENT	INTERRUPT (SYM.)		
TF2A	34.5 kV	200 kV	SM-5	300E AMPS	17.500	9311486	2023305[Y]

POWER FUSES – SM-5

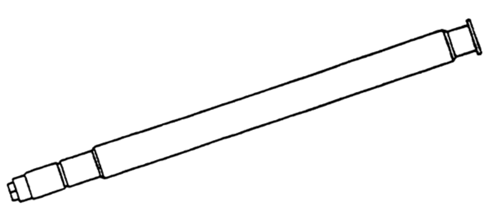
S & C type SM-5, 34.5 kV, power fuses for use with S & C type SM-5 power fuse holder, item TF2 and S & C type SM-5 power fuse mounting, item TS2. Units to be standard speed T.C.C. No. 153-4.



FUSE RATING (AMPERES)	STD ITEM	SAP ITEM ID	PS ITEM ID
100E	TF3A	9315204[Y]	0808053[Y]
125E	TF3B	9315203[Y]	0808054[Y]
150E	TF3C		0808055[Y]
175E	TF3D	9315202[Y]	0808056[Y]
200E	TF3E	9315187[Y]	0808051[Y]
250E	TF3F	9315201[Y]	0808057[Y]

POWER FUSES – SMD-1A

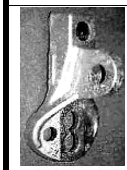
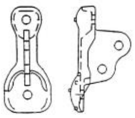
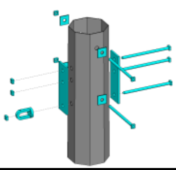
S & C type SMD-1A, 46 kV, power fuses for use with S & C vertical mounted power fuse and switch, item TS2P2. Units to be standard speed, T.C.C. number 153-1.



FUSE RATING (AMPERES)	STD ITEM	SAP ITEM ID	PS ITEM ID
100E	TF4A	9315330[Y]	0808410[Y]
125E	TF4B	9315312[Y]	0808411[Y]
150E	TF4C	9315329[Y]	0808412[Y]
175E	TF4D	9315328[Y]	0808413[Y]
200E	TF4E	9315327[Y]	0808414[Y]

PLATE, GUY EYE

Ductile iron per ASTM A536, hot dip galvanized per ASTM A153, applicable guy angle shall be 10˚ – 90° mounting hardware not included. For clevis and pin attachment of guys/strain insulators to pole.

	DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
	20,000 lbs. ultimate, 4” and 5” mounting bolt centers.	TG13	9313391	3503425
	36,000 lbs. ultimate, 8" mounting bolt center.	TG13D	9315098	0808691
	28,000 lbs. ultimate, 4” and 5” mounting bolt centers.	TG14	9306920	9200396
	30,000 lb. ultimate. 6” on center.	TG15	9307178	5994090
	For fiberglass pole guy installations - 12.5M max.	TG17	9306207	9201846

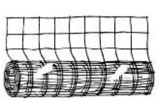
GROUND ROD, COPPER BONDED/COPPER-CLAD (SINGLE)

⅝” X 8’ solid ground rod, conically pointed at one end 60˚, cut square and chamfered at other end, 75,000 PSI minimal high strength steel core, 10 mils minimal copper plating thickness. Rods shall meet ANSI UL 467 and GR-1 specifications.

STD ITEM	SAP ITEM ID	PS ITEM ID
TG20	9313616	3503013

GRID, 8” X 8” POTENTIAL EQUALIZING

8” X 8” mesh fabricated of #6 AWG copperweld. 30% conductivity mesh with brazed joints supplied in 6’ wide X 100’ long rolls.



STD ITEM	SAP ITEM ID	PS ITEM ID	DESCRIPTION
TG21	9313614	3503039	6’ X 100’ Roll
TG21A	9307626	9202952	6’ X 5’-4” Mat

WIRE, GROUNDING LEAD

#10-7 strand, copperweld, dead soft, annealed, 40% conductivity, supplied in 100lb coil.

STD ITEM	SAP ITEM ID	PS ITEM ID
TG30	9314222	0809871

WIRE, GROUNDING LEAD

7-strand, 3/8-inch common grade galvanized steel strand, 4,250 lb , 25o-foot coils. For Sub-transmission down ground applications.

STD ITEM	SAP ITEM ID	PS ITEM ID
TG30A	9306353	5998530

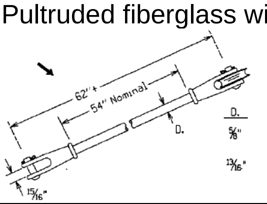
WIRE, GROUNDING LEAD

7-strand, 3/8-inch EHS, 15,400 lb, Class C galvanized coating per ASTM A363, 5,000-foot wood reel. For Sub-transmission shield wire applications.

STD ITEM	SAP ITEM ID	PS ITEM ID
TG51D	9309833	5105907

INSULATOR, GUY STRAIN

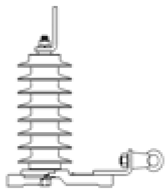
Pultruded fiberglass with galvanized ferrous clevis and roller. For use with STD Items TG13 and P54.



D.	CLEVIS PINS	TENSILE STRENGTH (MIN. ULT.)	LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
⅝"	⅝" d.	15000 lb.	54"	TI95B	9315006	3503621
13⁄16"	¾" d.	30000 lb.	54"	TI95C	9313698	3503623
13⁄16"	¾" d.	30000 lb.	78"	TI95D	9307240	5990864

SUB T LIGHTNING ARRESTER (WITH SUSPENSION CAP)

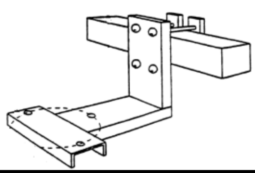
Intermediate Class Polymer housed MOV Surge Arrester furnished with a four hole NEMA pad line terminal and a loop through ground connector.



STD ITEM	SYS L-L VOLTAGE	DUTY CYCLE	MCOV RATING	SAP ITEM ID	PS ITEM ID
TL3N	23kV	24kVrms	19.5kV	9315336Y	0805062Y
TL3K	34.5kV	36kVrms	29kV	9315335Y	0805071Y
TL3L	46kV	48kVrms	39kV	9315334 Y	0805076 Y

SUB T CROSSARM MOUNTING BRACKET FOR INTERMEDIATE CLASS SURGE ARRESTER

Single crossarm mounting. Electric clearances must be observed. Maximum arrester size - 48kV MCOV. Pipe spacers included with attachment bolts to clear channel thickness and permit mounting the arrester with bracket in an inverted position. For crossarms 1 ½” x 4 ½” MIN., 4” x 6 ½” MAX.



STD ITEM	SAP ITEM ID	PS ITEM ID
TL11	9314998	0806623

TIE, PREFORMED

Consists of helix formed aluminum alloy wire element, protected in the center with a sheath of conductive neoprene complete with neoprene pad for use between conductor and insulator for F neck insulators. Use for distribution 336kcmil ACSR 3000lb construction per NESC rule 261F1a
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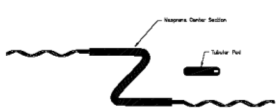
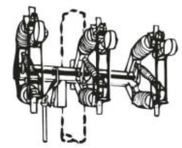


STD ITEM	SAP ITEM ID	PS ITEM ID
TT1B	9315812	3506719

SUB TRANSMISSION SWITCH, LOADBREAK

Gang-operated load break 200 kV BIL, switch with post insulators, interface shaft, vertical operating rod. (includes 7' FRP insulated section or Cypoxy insulator section), lockable operator handle and NEMA two hole terminal pads. Switch shall comply with latest ANSI STD C37.30 and Specification MS2778 and MS2779. Operating rod extension kits are available for taller pole installations (see below).


Upright Mounting Configuration

Vertical



Tiered-Outboard Mounting Configuration

NOMINAL VOLTAGE	CURR ENT	STYLE	Operating Rod Extension kit	STD ITEM	SAP ITEM ID	PS ITEM ID
25-34.5kV	600A	Horizontal	TSKIT15	D7F	9314410[E]	0811140[E]
25-34.5kV	600A	Horizontal	TSKIT15	TS6H	9315174	0807653
25-34.5kV	600A	Vertical	TSKIT125	TS6V	9315252	0805307
25-34.5kV	600A	Phase-over-phase	TSKIT125	TS6P	9315298	0808314
46kV	600A	Integer style Horizontal	TSKIT2	TS7K	9306245[Y]	9201832[Y]
46kV	600A	Horizontal w/vacuum interrupters	TSKIT2CP	TS7H	9393417	
34.5kV	-	3P Double Break with Power fuse *	TSKIT15	TS2P1	9315163[Y]	0808191[Y]
46kV	-	3P Double Break with Power fuse *	TSKIT15	TS2P2	9315164[Y]	0808190[Y]

* For fuses, see 22 - TF2A-TF4E.

Pipe Operating Rod Extension Kits

Consists of 10'- 4" section of galvanized pipe with rod guide or a guide bearing assembly and required hardware for S&C switches.

* Gaining Channel only required for S&C switches with 1 ¼" IPS pipe built prior to 2013.

Description	STD ITEM	SAP ITEM ID
1 ¼" Reciprocating	TSKIT125	9391228
1 ½" Torsional	TSKIT15	9391227
2" Torsional	TSKIT2	9391230

Pipe Operating Rod Extension Kit for Cleveland Price Switch

Consists of 21'- 2" section of galvanized pipe, pipe coupling and additional guide bracket for Cleveland Price switches.

Description	STD ITEM	SAP ITEM ID
2" Torsional	TSKIT2CP	9393536

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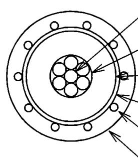
CABLE, 600V, COPPER, 1/C

600V, soft drawn copper conductor, standard concentric round or compressed, thermosetting black cross linked polyethylene, for use with 3 phase transformer bank connections.

STD ITEM	SAP ITEM ID	PS ITEM ID
UC5G	9302666	5949290

CABLE, 15 kV, ALUMINUM, URD PRIMARY

#2 AWG, single conductor, shielded, solid dielectric, insulated aluminum power cable with concentric neutral wires and semi conducting polyethylene jacket. For URD applications only. Suitable for random lay direct burial installations or for duct installation. Cables shall be in accordance with ~~National Grid~~PPL specification MS 5013 latest edition.



Max. Reel Size	54" W x 70" D
Preferred Splice – URD Application	UR50
Preferred Splice – Duct & Manhole Application	UR51A
Preferred Termination	UR42

CONDUCTOR		O.D.		REEL				
SIZE AWG	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT	STD ITEM	SAP ITEM ID	PS ITEM ID
2 Al	1/C	0.695"	1.015	3000'	1500	UC11BC	9313027	5948279

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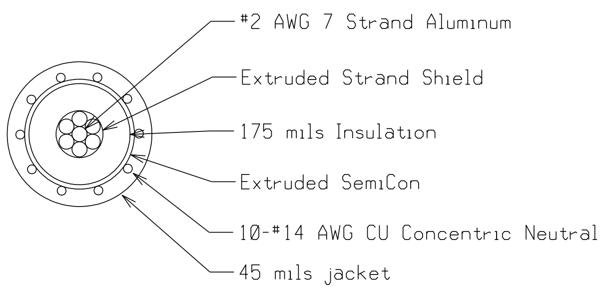
CABLE, 15 kV, ALUMINUM

#2 AWG, single conductor, shielded, solid dielectric, insulated aluminum power cable with concentric neutral wires and polyethylene jacket. Cables shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition.



Max. Reel Size	44" W x 72" D
Preferred Splice	UR51A
Preferred Termination	UR42

CONDUCTOR		O.D.		REEL				
SIZE AWG	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT LBS	STD ITEM	SAP ITEM ID	PS ITEM ID
2 Al	3-1/C	0.695"	1.015	2000'	3360	UC11BJ	9315698	4026122

[1]This Item appears in other CUs
[2]This CU contains additional items needed for installation per standards
[3]This item has a CU with labor/material and a CU with material only

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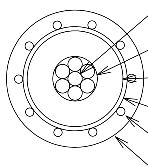
CABLE, 15 kV, COPPER

#2 AWG, single conductor, shielded, solid dielectric, insulated copper power cable with concentric neutral wires and polyethylene jacket. Cables shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition



Max. Reel Size	54" W x 70" D
Preferred Splice	UR51A
Preferred Termination	UR42

CONDUCTOR		O.D.		REEL				
SIZE AWG	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT LBS	STD ITEM	SAP ITEM ID	PS ITEM ID
2 Cu	1/C	0.695"	1.015	2000'	1200	UC11BK	9301804	5430350
2 Cu	3-1/C	0.695"	1.015	2000'	3600	UC11BL	9309888	5106006

[1]This Item appears in other CUs
[2]This CU contains additional items needed for installation per standards
[3]This item has a CU with labor/material and a CU with material only

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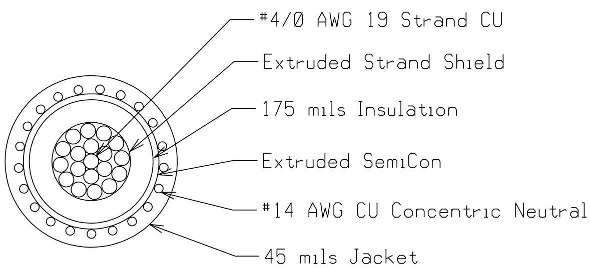
CABLE, 15 kV, COPPER

#4/0 AWG, single conductor, shielded, solid dielectric, insulated copper power cable with concentric neutral wires and polyethylene jacket. Cables shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition



Max. Reel Size	54" W x 72" D
Preferred Splice	UR51A
Preferred Termination	UR44C

CONDUCTOR		O.D.		REEL				
SIZE AWG	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT LBS	STD ITEM	SAP ITEM ID	PS ITEM ID
4/0 Cu	3-1/C	0.92"	1.24"	1500'	6750	UC11E	9314217	0809935

[1]This Item appears in other CUs
[2]This CU contains additional items needed for installation per standards
[3]This item has a CU with labor/material and a CU with material only

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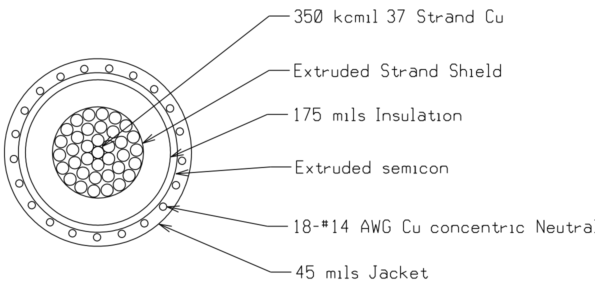
CABLE, 15 kV, COPPER

350 kcmil, single conductor, shielded, solid dielectric, insulated copper power cable with concentric neutral wires and polyethylene jacket. Cables shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition



Max. Reel Size	60" W x 96" D
Preferred Splice	UR51B
Preferred Termination	UR44C

CONDUCTOR		O.D.		REEL				
SIZE kcmil	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT	STD ITEM	SAP ITEM ID	PS ITEM ID
350	3-1/C	1.08"	1.42"	1000’	5400	UC12F	9308986	5107155

[1]This Item appears in other CUs
[2]This CU contains additional items needed for installation per standards
[3]This item has a CU with labor/material and a CU with material only

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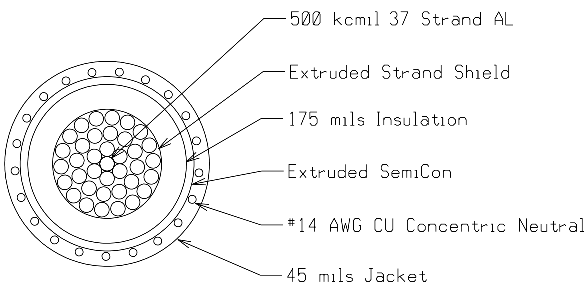
CABLE, 15 kV, ALUMINUM

500 kcmil, single conductor, shielded, solid dielectric, insulated aluminum power cable with concentric neutral wires and polyethylene jacket. Cables shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition



Max. Reel Size	60" W x 96" D
Preferred Splice	UR51B or UR51F
Preferred Termination	UR44C

CONDUCTOR		O.D.		REEL				
SIZE kcmil	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT LBS	STD ITEM	SAP ITEM ID	PS ITEM ID
500	3-1/C	1.21"	1.55"	1500'	6750	UC12GG	9314218	0809922

[1]This Item appears in other CUs
[2]This CU contains additional items needed for installation per standards
[3]This item has a CU with labor/material and a CU with material only

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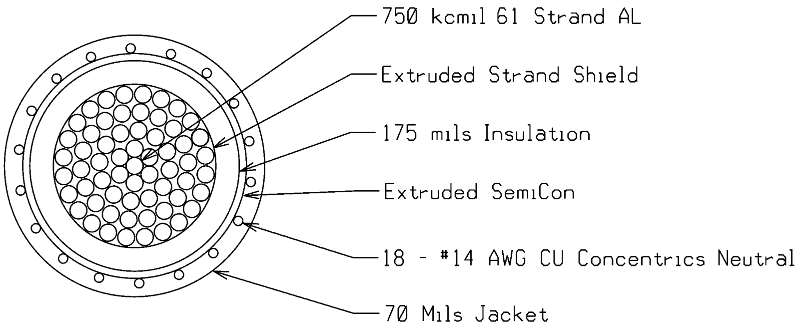
CABLE, 15 kV, ALUMINUM

750 kcmil, single conductor, shielded, solid dielectric insulated aluminum power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition.



Reel Size	44" W x 78" D
Preferred Splice	UR51C
Preferred Termination	UR44D

CONDUCTOR		O.D.		REEL				
SIZE kcmil	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT LBS	STD ITEM	SAP ITEM ID	PS ITEM ID
750	3-1/C	1.40"	1.74"	900'	5940	UC12HG	9314216Y	0809923Y

1This Item appears in other CUs
2This CU contains additional items needed for installation per standards
3This item has a CU with labor/material and a CU with material only

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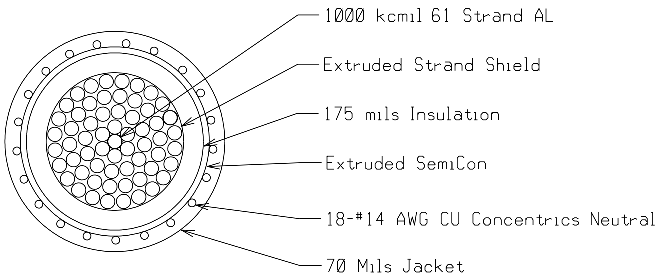
CABLE, 15 kV, ALUMINUM

1000 kcmil, single conductor, shielded, solid dielectric insulated aluminum power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition.



Reel Size	60" W x 96" D
Preferred Splice	UR51C
Preferred Termination	UR44D

CONDUCTOR		O.D.		REEL				
SIZE kcmil	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT LBS	STD ITEM	SAP ITEM ID	PS ITEM ID
1000	3-1/C	1.545"	1.98"	1000'	8100	UC12TA	9308997	5107173
1000	1/C	1.545"	1.98"	3000'	8100	UC12TB	9310595[E]	9200995[E]

[1]This Item appears in other CUs
[2]This CU contains additional items needed for installation per standards
[3]This item has a CU with labor/material and a CU with material only

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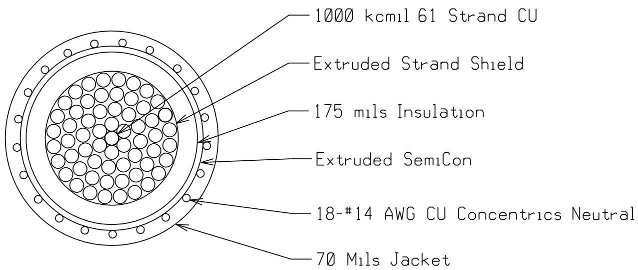
CABLE, 15 kV, COPPER

1000 kcmil, single conductor, shielded, solid dielectirc, insulated copper power cable with concentric neutral wires and polyethylene jacket. Cables shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition



Max. Reel Size	60" W x 96" D
Preferred Splice	UR51C
Preferred Termination	UR44D

CONDUCTOR		O.D.		REEL				
SIZE kcmil	PACKAGE	INS.	JACKET	Ckt. Ft.	Weight Lbs	STD ITEM	SAP ITEM ID	PS ITEM ID
1000	3-1/C	1.545"	1.98"	900'	11340	UC12TC	9309012	5107262
1000	1-1/C	1.545"	1.98"	2700'	11340	UC12TD	9389825[E]	N/A

[1]This Item appears in other CUs
[2]This CU contains additional items needed for installation per standards
[3]This item has a CU with labor/material and a CU with material only

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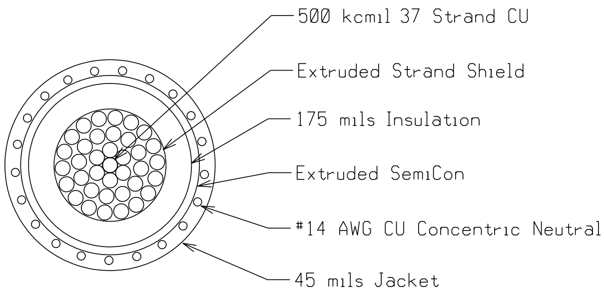
CABLE, 15 kV, COPPER

500 kcmil, single conductor, shielded, solid dielectric, insulated copper power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition.



Max. Reel Size	60" W x 96" D
Preferred Splice	UR51B or UR51F
Preferred Termination	UR44C

CONDUCTOR		O.D.		REEL				
SIZE kcmil	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT	STD ITEM	SAP ITEM ID	PS ITEM ID
500	3-1/C	1.21"	1.55"	1100	9240	UC17	9314186	0810376

[1]This Item appears in other CUs
[2]This CU contains additional items needed for installation per standards
[3]This item has a CU with labor/material and a CU with material only

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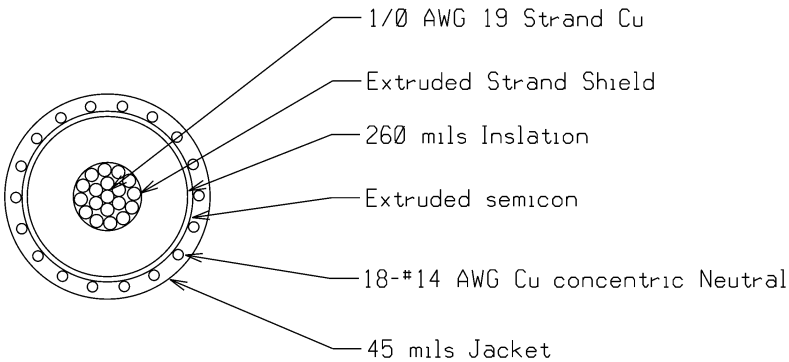
CABLE, 25 kV, COPPER

1/0 AWG, single conductor, shielded, solid dielectric insulated copper power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition.



Reel Size	45" W x 80" D
Preferred Splice	UR51B
Preferred Termination	UR44C

CONDUCTOR		O.D.		REEL				
SIZE AWG	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT LBS	STD ITEM	SAP ITEM ID	PS ITEM ID
1/0	3-1/C	0.94"	1.25"	1000	2910	UC23CJ	9316006[Y]	4033356[Y]

[1]This Item appears in other CUs
[2]This CU contains additional items needed for installation per standards
[3]This item has a CU with labor/material and a CU with material only

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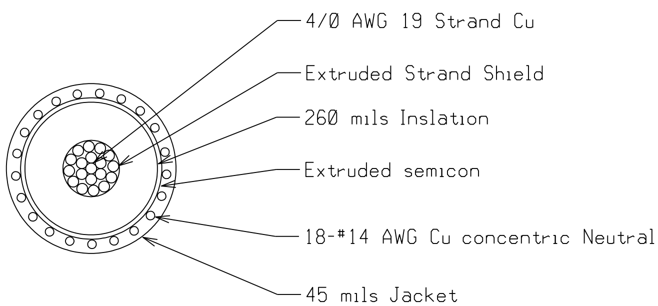
CABLE, 25 kV, COPPER

4/0 AWG, single conductor, shielded, solid dielectric insulated copper power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition.



Reel Size	54" W x 70" D
Preferred Splice	UR51B
Preferred Termination	UR44D

CONDUCTOR		O.D.		REEL				
SIZE AWG	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT	STD ITEM	SAP ITEM ID	PS ITEM ID
4/0	3-1/C	1.09"	1.43"	1000	4500	UC23EC	9308996[E]	5107164[E]

[1]This Item appears in other CUs
[2]This CU contains additional items needed for installation per standards
[3]This item has a CU with labor/material and a CU with material only

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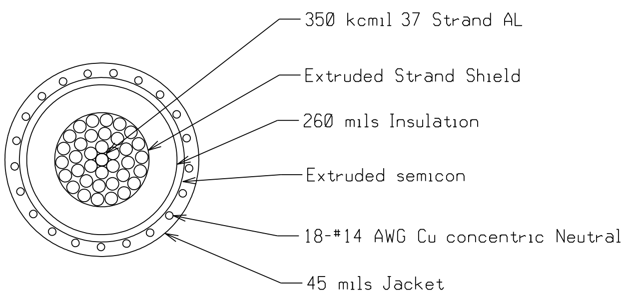
CABLE, 25 kV, ALUMINUM

350 kcmil, single conductor, shielded, solid dielectric insulated aluminum power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition.



Reel Size	60" W x 96" D
Preferred Splice	UR51B
Preferred Termination	UR44D

CONDUCTOR		O.D.		REEL				
SIZE kcmil	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT LBS	STD ITEM	SAP ITEM ID	PS ITEM ID
350	3-1/C	1.26"	1.60"	1500	6300	UC23FA	9308980[E]	5107128[E]

[1]This Item appears in other CUs
[2]This CU contains additional items needed for installation per standards
[3]This item has a CU with labor/material and a CU with material only

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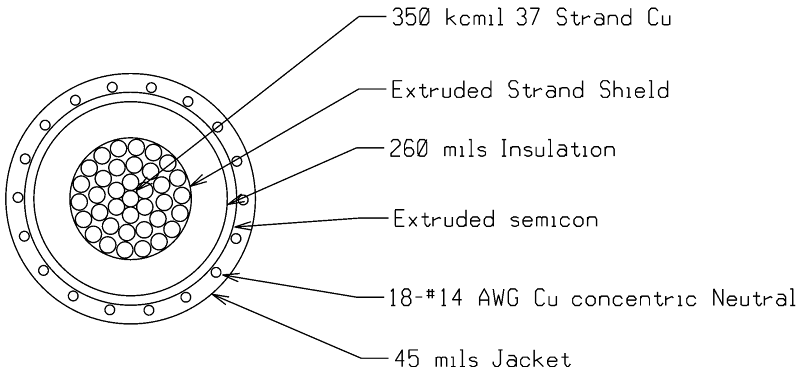
CABLE, 25 kV, COPPER

350 kcmil, single conductor, solid dielectric insulated copper power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition



Max. Reel Size	56" W x 78" D
Preferred Splice	UR51B
Preferred Termination	UR44C

CONDUCTOR		O.D.		REEL				
SIZE kcmil	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT LBS	STD ITEM	SAP ITEM ID	PS ITEM ID
350	3-1/C	1.26"	1.58"	1000'	6600	UC23FJ	9316005[Y]	4033357[Y]

[1]This Item appears in other CUs
[2]This CU contains additional items needed for installation per standards
[3]This item has a CU with labor/material and a CU with material only

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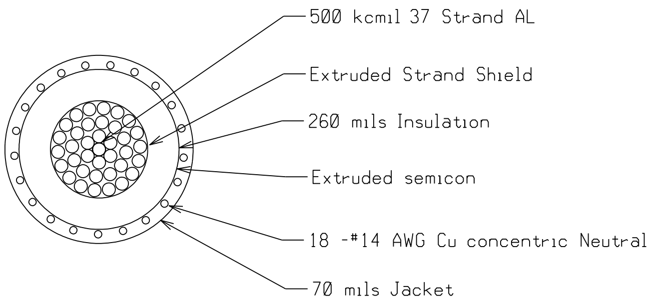
CABLE, 25 kV, ALUMINUM

500 kcmil, single conductor, shielded, solid dielectric insulated aluminum power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition.



Reel Size	60" W x 96" D
Preferred Splice	UR51C or UR51F
Preferred Termination	UR44D

CONDUCTOR		O.D.		REEL				
SIZE kcmil	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT LBS	STD ITEM	SAP ITEM ID	PS ITEM ID
500	3-1/C	1.39"	1.795"	1000	5400	UC23GA	9308998[E]	5107182[E]

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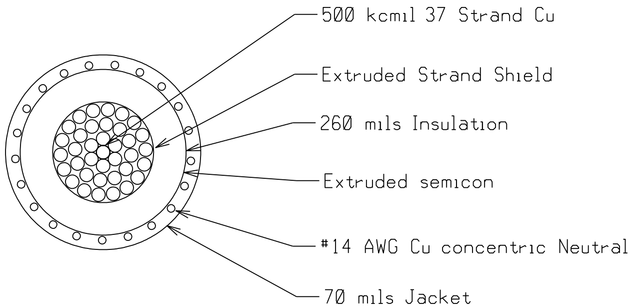
CABLE, 25 kV, COPPER

500 kcmil, single conductor, shielded, solid dielectric insulated copper power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition.



Reel Size	60" W x 96" D
Preferred Splice	UR51C or UR51F
Preferred Termination	UR44E

CONDUCTOR		O.D.		REEL				
SIZE kcmil	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT LBS	STD ITEM	SAP ITEM ID	PS ITEM ID
500	3-1/C	1.39"	1.665"	1000	9300	UC23GJ	9314170	0810924

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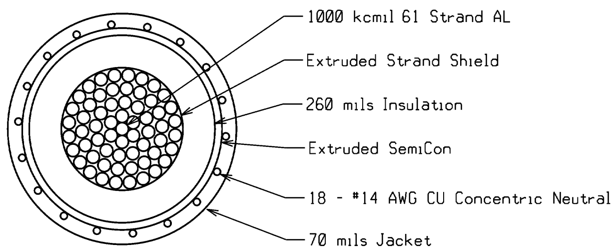
CABLE, 25 kV, ALUMINUM

1000 kcmil, single conductor, shielded, solid dielectric insulated aluminum power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition.

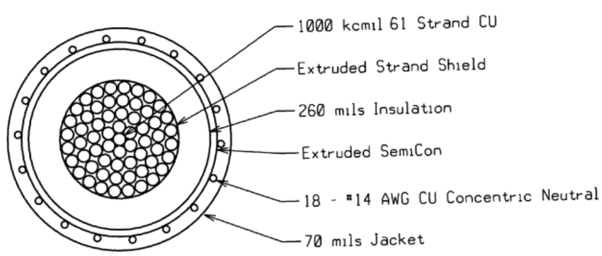


Reel Size	60" W x 96" D
Preferred Splice	UR51C
Preferred Termination	UR44E

CONDUCTOR		O.D.		REEL				
SIZE kcmil	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT LBS	STD ITEM	SAP ITEM ID	PS ITEM ID
1000	3-1/C	1.725"	2.16"	1000	9000	UC23TA	9309015	5107191

CABLE, 25 kV, COPPER

1000 kcmil, single conductor, shielded, solid dielectric insulated copper power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition.



Reel Size	60" W x 96" D
Preferred Splice	UR51C
Preferred Termination	UR44E

CONDUCTOR		O.D.		REEL				
SIZE kcmil	PACKAGE	INS.	JACKET	CKT. FT.	WEIGHT LBS	STD ITEM	SAP ITEM ID	PS ITEM ID
1000	3-1/C	1.725"	2.16"	850	13770	UC23TC	9306707	9201889

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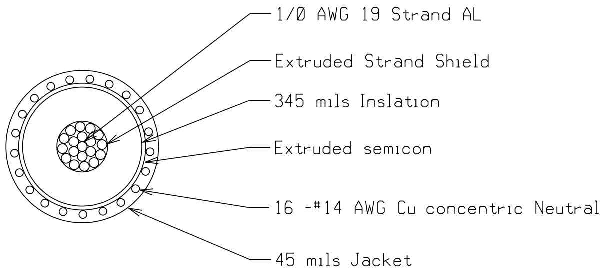
CABLE, 35 kV, ALUMINUM

1/0 AWG, single conductor, shielded, solid dielectric insulated, aluminum power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition.



Reel Size	54” W x 70” D
Preferred Splice	UR51D
Preferred Termination	UR45B1

CONDUCTOR		O.D.		REEL				
SIZE AWG	PACKAGE	INS.	JACKET	CKT. FT	WEIGHT LBS	STD ITEM	SAP ITEM ID	PS ITEM ID
1/0	1/C	1.11"	1.45"	3000	2880	UC35C1	9321948[E]	5948318[E]
1/0	3-1/C	1.11"	1.45"	1500	4320	UC35C3	9312773	5948319

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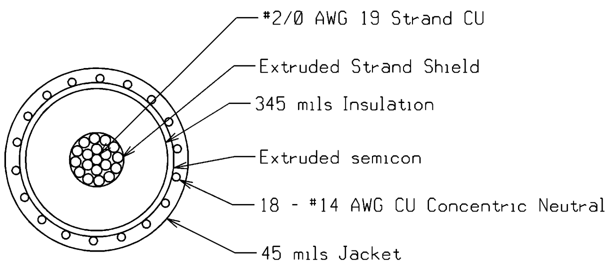
CABLE, 35 kV, COPPER

2/0 AWG, single conductor, shielded, solid dielectric insulated copper power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL Specification MS 4168 latest edition.



Max. Reel Size	42" W x 75" D
Preferred Splice	UR51D
Preferred Termination	UR45B1

CONDUCTOR		O.D.		REEL		STD ITEM	SAP ITEM ID	PS ITEM ID
SIZE AWG	PACKAGE	INS.	JACKET	CKT. FT	WEIGHT LBS			
2/0	3-1/C	1.20"	1.53"	1000	4050	UC35DJ	9316002[Y]	4034002[Y]

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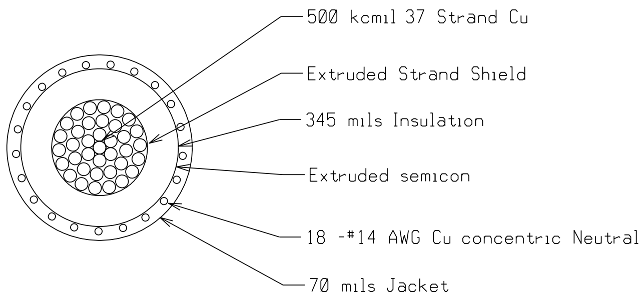
CABLE, 35 kV, COPPER

500 kcmil, single conductor, shielded, solid dielectric insulated, copper power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition.



Max. Reel Size	55" W x 78" D
Preferred Splice	UR51E
Preferred Termination	UR45C3

CONDUCTOR		O.D.		REEL				
SIZE kcmil	PACKAGE	INS.	JACKET	CKT. FT	WEIGHT LBS	STD ITEM	SAP ITEM ID	PS ITEM ID
500	3-1/C	1.56"	1.96"	1000	10200	UC35GJ	9306942	9200387

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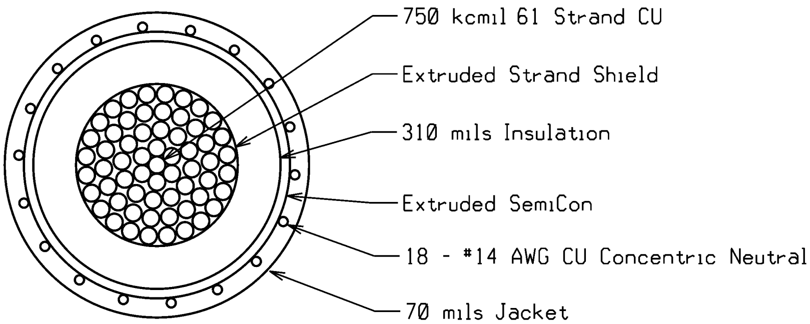
CABLE, 35 kV, COPPER

750 kcmil, single conductor, shielded, solid dielectric insulated copper power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition.



Max. Reel Size	55" W x 84" D
Preferred Splice	UR51E
Preferred Termination	UR45H

CONDUCTOR		O.D.		REEL				
SIZE kcmil	PACKAGE	INS.	JACKET	CKT. FT	WEIGHT LBS	STD ITEM	SAP ITEM ID	PS ITEM ID
750	3-1/C	1.73"	2.09"	900	12420	UC35HJ	9316001[Y]	4034075[Y]

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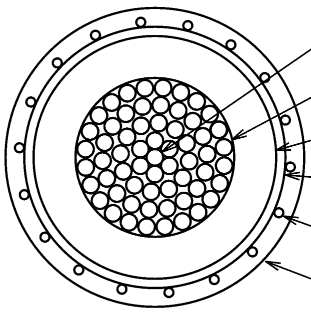
CABLE, 35 kV, COPPER

1000 kcmil, single conductor, shielded, solid dielectric insulated, copper power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition.



Reel Size	60" W x 96" D
Preferred Splice	UR51E
Preferred Termination	UR45H

CONDUCTOR		O.D.		REEL		STD ITEM	SAP ITEM ID	PS ITEM ID
SIZE kcmil	PACKAGE	INS.	JACKET	CKT. FT	WEIGHT LBS			
1000	3-1/C	1.95"	2.31"	800	13680	UC35TC	9302670E	5949570E
1000	1/C	1.95"	2.31"	2000	11400	UC35TD	9306247	9201830

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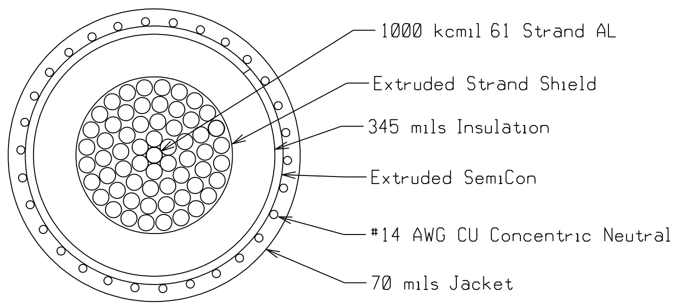
CABLE, 35 kV, ALUMINUM

1000 kcmil, single conductor, shielded, solid dielectric insulated, aluminum power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL specification MS 4168 latest edition.



Reel Size	50" W x 84" D
Preferred Splice	UR51E
Preferred Termination	UR45H

CONDUCTOR		O.D.		REEL		STD ITEM	SAP ITEM ID	PS ITEM ID
SIZE kcmil	PACKAGE	INS.	JACKET	CKT. FT	WEIGHT			
1000	3-1/C	1.95"	2.31"	1000	9900	UC35TJ	9309014	5107208

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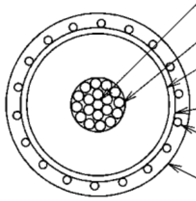
CABLE, 46 kV, COPPER

4/0 AWG, single conductor, shielded, solid dielectric insulated copper power cable with concentric neutral wires and polyethylene jacket. Cable shall be in accordance with ~~National Grid~~PPL Specification MS 4169 latest edition.



Max. Reel Size	60" W x 96" D
Preferred Splice	
Preferred Termination	UR46

CONDUCTOR		O.D.		REEL		STD ITEM	SAP ITEM ID	PS ITEM ID
SIZE AWG	PACKAGE	INS.	JACKET	CKT. FT	WEIGHT LBS *			
4/0	3-1/C	1.46"	1.788"	1000	6210	UC46	9390798Y	n/a

*Approximate weight of cable does not include weight of reel.

CONNECTOR, COMPRESSION, COPPER

Tinned copper compression connector with center oil / water stop. Designed for joining copper conductors end to end. These connectors are selected to meet the dimensional requirements of all high voltage splice kits used in the company. Splice shall be in accordance with ANSI C119.4, Class A, Class 2 min.

WIRE SIZE	BCT 500		Y35		Y46		STD ITEM	SAP ITEM ID	PS ITEM ID
	Die	Crimp	Die	Crimp	Die	Crimp			
4/0	W28RT	4	U28RT	2	*	2	UC60E	9310121	9201227

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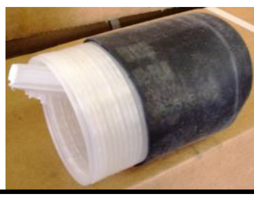
CLEANER, CABLE, CAN

STD ITEM	SAP ITEM ID	PS ITEM ID
UC80F	9305779	5643847

END CAP, CABLE, COLD SHRINK

Cable end cap intended for use on solid dielectric cable at all voltages to prevent the ingress of moisture during storage and installation.



OUTER JACKET O.D.		STD ITEM	SAP ITEM ID	PS ITEM ID
MIN	MAX			
0.46	0.86	UC90C	9306242	9201844
0.63	1.18	UC90E	9309862	5102002
1.02	1.94	UC90H	9304341	5641118
1.79	3.32	UC90J	9304340	5641119

FOAM, EXPANDING

Expanding foam, for sealing conduits on riser poles and transformer pads. With nozzle. UV Resistant. Replacement nozzle also available.

	STD ITEM	SAP ITEM ID	PS ITEM ID
Can w/ Nozzle	UF10	9305542	5106645
Replacement nozzle	UF10A		5106647

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FOAM, FIREPROOF

Foam, fireproof, for use in UG conduit systems, fire rated polyurethane expanding foam, 10oz can with spray type nozzle applicator, foam expands two to three times its size when dispensed, pink, cures fully in 12 hours. 24oz cans have been discontinued okay to use up existing stock..

	STD ITEM	SAP ITEM ID	PS ITEM ID
24 Oz can	UF20	9307975	9202670
10 Oz can	UF20	9387426	none

CLIP, GALVANIZED CONDUIT

Galvanized steel, 2-hole pipe strap. For fastening rigid galvanized steel conduit to a riser pole. In accordance with ~~National Grid~~PPL Material Specification MS-3255.

CONDUIT SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
2”	UK3B	9309510	5641200
3”	UK3C	9309509	5641205
4”	UK3D	9310459	5641210
5”	UK3E	9309516	5641215
6”	UK3F	9309527	5641216

CONDUIT, PVC, TYPE DB

Polyvinyl-chloride (PVC) type DB conduit. Designed for direct burial without encasement in concrete; also suitable for concrete encasement. One belled end per length, solvent welded.

SIZE	MIN WALL	LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
2”	.060”	20’	UK6A2	9316084	2010402
3”	.092”	20’	UK6A3	9317764	5692158
4”	.121”	20’	UK6A4	9314994	2010404
5”	.152”	20’	UK6A5	9316083	2010405
6”	.182”	20’	UK6A6	9316185	2010406

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COUPLING, PVC

Female coupling for type DB conduit, solvent welded. Sizes 2" and smaller also suitable for use with Schedule 40 conduit.

SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
¾"	UK6C0	9316135[Y]	2010457[Y]
1¼"	UK6C1	9316134	2010458
2"	UK6C2	9316140	2010452
3"	UK6C3	9316139	2010453
4"	UK6C4	9316138	2010454
5"	UK6C5	9316137	2010455
6"	UK6C6	9316136	2010456

ADAPTER, PVC, FEMALE

Adapter for type DB or Schedule 40 conduit. Female solvent welded to female threads. For transition from PVC conduit to threaded steel conduit.

SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
¾"	UK6F0	9320824[E]	5690060[E]
2"	UK6F2	9316195	2010432
3"	UK6F3	9316194	2010433
4"	UK6F4	9316193	2010434
5"	UK6F5	9316192	2010435
6"	UK6F6	9316191	2010436

CEMENT, PVC

Solvent cement for use with PVC conduit and fittings. Furnished in pint cans with brush top applicator.

STD ITEM	SAP ITEM ID	PS ITEM ID
UK6S	9320383	8010168

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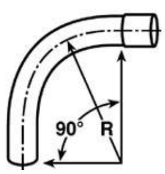
CONDUIT, PVC, SCHEDULE 40

Polyvinyl-chloride (PVC) schedule 40 conduit. For installations where conduit will remain exposed. For buried installations, use type DB conduit, standard item UK6A. One belled end per length.

SIZE	MIN. WALL	LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
¾"	0.113"	10'	UK7A0	9316557	2011155
1¼"	0.140"	10'	UK7A1	9316549	2011156
2"	0.154"	20'	UK7A2	9316596	2011028
3"	0.216"	20'	UK7A3	9316543	2011169
4"	0.237"	20'	UK7A4	9316545	2011167
5"	0.258"	10'	UK7A5	9316560	2011185
6"	0.280"	10'	UK7A6	9317747[E]	5692130[E]

BEND/SWEEP, PVC, 90º

Bend/sweep for Schedule 40 conduit, one belled end per bend/sweep, solvent welded.



SIZE	RADIUS	STD ITEM	SAP ITEM ID	PS ITEM ID
¾"	4½"	UK7B0	9316098[Y]	2010169[Y]
1¼"	7¼"	UK7B1	9316097[Y]	2010170[Y]
2"	18"	UK7B2	9316096	2010171
4"	36"	UK7B4	9320743	5690493
5"	36"	UK7B5	9320742	5690494
4"	24"	UK7B6	9307496	9202438
5"	24"	UK7B7	9307552	9202440

NOTE: UK7B6 and UK7B7 are for network services ONLY.

ADAPTER, MALE, SCHEDULE 40 PVC CONDUIT

Adapter for type DB or Schedule 40 conduit. Female solvent welded to male threads. For transition from PVC conduit to threaded steel conduit or outlet boxes.

SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
¾	UK7M0	9316190	2010437
1¼	UK7M1	9316189[Y]	2010438[Y]
3	UK7M3	9321562[E]	5690087[E]

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TEE, PVC

Tee for Schedule 40 conduit, solvent welded.

SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
3/4	UK7T0	9316085	2010325

BOX, RECEPTACLE, PVC – ¾"

Molded PVC outdoor receptacle housing with non-threaded ¾" conduit entrance. Light grey.

STD ITEM	SAP ITEM ID	PS ITEM ID
UK8B	9311821	2030350

RECEPTACLE, ELECTRICAL BOX

Weatherproof and corrosion resistant single 20A, 125V polarized receptacle with mounting plate, screws and hinged lift cover. Yellow.

NEMA
NO. 5 - 20

STD ITEM	SAP ITEM ID	PS ITEM ID
UK8R	9311819[Y]	2030352[Y]

WEATHERHEAD – ¾" PVC SERVICE ENTRANCE

Non-threaded molded PVC weatherhead for ¾" PVC conduit (STD ITEM UK7A0). 3-wire, light grey.

STD ITEM	SAP ITEM ID	PS ITEM ID
UK8W	9311822[Y]	2030348[Y]

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PRIMARY METERING SECONDARY MISC FITTINGS

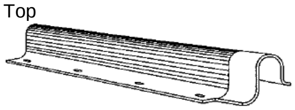


DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
1” x 5” Galvanized Nipple	UK9	9388416	
1” Cast Aluminum Meter hub	UK9B	9388415	
1” T Conduit Body - Aluminum	UK10	9316174	
1” T T Conduit Body - Aluminum Cover	UK10A	9316173	

GUARD, RISER (U-DUCT)

High Density Polyethylene furnished in 5’ lengths. Attach to wood pole using ¼” X 2” lag screws. (STD ITEM B10B).

Top



Bottom (Bell end)

COND. SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
2”	UK11D	9310574	9201325
3”	UK11E	9306271	9201880
4”	UK11F	9306263	9201881
5”	UK11G	9306261	9201882
6”	UK11H	9306713	9201883

GUARD, RISER, GALVANIZED STEEL

Galvanized steel, U-Guard, furnished in 8’ lengths, to protect cables. This item shall only be used on risers built to old NiMo standard, not for new construction.


Type	INSIDE DIA	STD ITEM	SAP ITEM ID	PS ITEM ID
Guard	3.7”	UK12	9389845	N/A
Strap		UK12A	9389846	N/A

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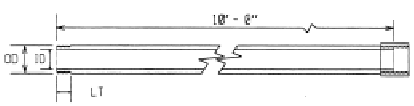
GUARD, RISER, REDUCER

PVC / acrylic reducer, for use with riser guard STD ITEM UK11 and for connecting riser guard item UK11 to steel conduit item UK31.

SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
6" X 4"	UK14GF	9316156	2010545

CONDUIT, GALVANIZED STEEL

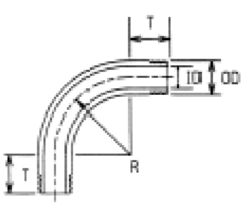
Hot-dip galvanized mild rigid steel in accordance with Underwriters' Laboratories Standard UL6, Federal Specification WW-C-581d, and ANSI C80. Threads shall be galvanized, threaded both ends, supplied with 1 coupling.



SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
¾"	UK30A	9316148	2011016
1"	UK30B	9316147	2011017
1¼"	UK30C	9316146	2011018
2"	UK30D	9316330	2011020
3"	UK30E	9317751	5692107
4"	UK30F	9316663	2011024
5"	UK30G	9316374	2011025
6"	UK30H	9316597	2011027

SWEEP, GALVANIZED CONDUIT, 90°

Galvanized bend/sweep, threaded on both ends.



SIZE	R	T (Min)	STD ITEM	SAP ITEM ID	PS ITEM ID
¾"	4½"	2 ½"	UK31A	9316593[Y]	2011036[Y]
1"	5¾"	2 ½"	UK31B	9316592[Y]	2011037[Y]
1¼"	7¼"	2 ½"	UK31C	9316188[Y]	2011038[Y]
2"	24"	8"	UK31D	9321012[E]	5690424[E]
2"	9½"	4"	UK31D1	9316187	2011040
2"	36"	11"	UK31D2	9316598[Y]	2011026[Y]
3"	36"	11"	UK31E	9320771	5690436
4"	36"	11"	UK31F	9320770[E]	5690446[E]
4"	24"	11"	UK31F1	9316550	2011150
4"	42"	12"	UK31F2	9316587	2011044
5"	36"	12 ½"	UK31G	9320769[E]	5690456[E]
5"	24"	11"	UK31G1	9316547[Y]	2011164[Y]
5"	48"	12"	UK31G2	9314992	2011045
6"	60"	12	UK31H	9316602	2011070
6"	48"	12"	UK31H2	9306286	9202114

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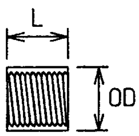
COUPLING, GALVANIZED CONDUIT



SIZE (in)	STD ITEM	SAP ITEM ID	PS ITEM ID
1	UK32B	9316586Y	2011057Y
1¼	UK32C	9316585Y	2011058Y
2	UK32D	9316583	2011060
3	UK32E	9317481	5693350
4	UK32F	9316599	2011064
5	UK32G	9316601	2011065
6	UK32H	9316620	2011067

PLUG, GALVANIZED

Galvanized steel plug for threaded rigid galvanized steel conduit (Std Item UK30).

SIZE (in)	STD ITEM	SAP ITEM ID	PS ITEM ID
2	UK34D	9307515	9202870
3	UK34E	9306819	9201659
4	UK34F	9316062	2011254
5	UK34G	9314990	2011255
6	UK34H	9315221Y	0803813Y

PLUG, CONDUIT

Used to temporarily plug conduits/riser pipes. Metal loop allows for muletape to be tied off to the plug.

PIPE ID	PLUG RANGE	STD ITEM	SAP ITEM ID	PS ITEM ID
2”	1.83” - 2.36”	UK34J	9308104	9202199
3”	2.99” - 3.46”	UK34K	9308121	9202200
4”	3.94” - 4.17”	UK34K2	9316161	9202624
5”	5.00” - 5.35”	UK34L	9308120	9202201
6”	5.82” - 6.37”	UK34M	9308119	9202202

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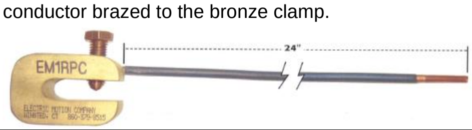
CLAMP, CONDUIT GROUND

Heavy duty corrosion-resistant ground clamp with silicone bronze hardware for galvanized steel conduit, item UK30, to ground steel conduit. Furnished with a mechanical grounding cable connector permitting the grounding cable to be attached either parallel with or at right angles to the steel conduit, with a cable range of #4 solid thru #4/0 stranded.

PIPE SIZE (IN)		STD ITEM	SAP ITEM ID	PS ITEM ID
IPS	OD			
1¼-2	1.6-2.3	UK38D	9313608	3503073
2.5-3.5	2.8-4.0	UK38E	9313606	3503075
4-5	4.5-5.5	UK38F	9313607	3503074
6	6.6	UK38H	9313611	3503067

CLAMP, RISER CONDUIT GROUND

Bronze clamp connector used to bond metallic conduit on riser poles to down ground. Clamp installs at the top of the metallic conduit, at open end. Connector comes with a 24" long #4 AWG insulated conductor brazed to the bronze clamp.



STD ITEM	SAP ITEM ID	PS ITEM ID
UK39	9387032	NONE

STRAP, CONDUIT – IRON

Galvanized malleable iron, single hole clamp for use with standard ½" & ¾" rigid conduit.

STEEL CONDUIT SIZE (NOMINAL, INCHES)	STD ITEM	SAP ITEM ID	PS ITEM ID
½	UK45A1	9316128	2010474
¾	UK45A2	9316127	2010475
1"	UK45A3	9387021	None

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LEADER, CONDUIT - NYLON

Clear, flexible nylon cable protector with end sleeve for standard riser conduit or cable ducts. Approximately 0.06" or 1.52 mm thick.

NOMINAL CONDUIT SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
2" – 2½"	UK49A	9316538	2015106
3" – 5"	UK49B	9311889	2015110

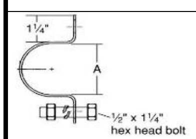
BRACKET, CONDUIT STANDOFF

Bracket used to attach riser conduits to a pole. Mounts to pole using two holes spaced 3 5/8" apart using 5/8" thrubolts and ½" lag (not included). Stands 6" away from the pole.

BRACKET LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
12"	UK60	9306797	9202147
24"	UK60A	9307865	9202271

KIT, CONDUIT STRAP

Conduit strap to be used with Std Item UK60 (Conduit Standoff Bracket). Includes strap, two hex-head bolts, two lockwashers, and two hex nuts. The bolt heads are sized to be able to slide into the standoff bracket.



CONDUIT SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
2"	UK61A	9306738	9202142
3"	UK61B	9306739	9202143
4"	UK61C	9306740	9202144
5"	UK61D	9306741	9202145
6"	UK61E	9306798	9202146

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LIMITER, CURRENT LIMITING, CABLE-TO-MOLE

Cable-to-mole limiter, current limiting, 200,000 amps symmetrical interrupting rating, 600V. For use on network secondary services. Use insulating sleeve UL5S.

CU. CABLE SIZE	TOOL & DIE Y34A IND.	Y34A NEST.	Indents	Y35 or Y39	Crimps	Y45	Crimps	Y46	Crimps
4/0	Y28PR	A28D	1	U28RT	1	✳	1	✳✳	1
500	Y34PR	A34D	2	U34RT	2	✳	2	✳✳	2

✳ Use Y35 die with “S” adapter (Burndy Cat. No. PT-6515)
✳✳ Use Y35 die with “P” adapter (Burndy Cat. No. P-UADP)

Cable Size	Socket	Cone	STD ITEM	SAP ITEM ID	PS ITEM ID
4/0 AWG	UC51A	UC52A2	UL3B	9306612	9201989
500 kcMil	UC51C	UC52C6	UL3E	9306610	9201991

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LUG, TERMINAL, COPPER

Tinned copper lug with NEMA 2 or 4 hole pad (9/16" holes @ 1 3/4" spacing). Lugs are sealed to prevent water intrusion into the cable. For use on copper cable terminations. See Section 34 for die / crimping information.

SIZE AWG / kcmil	STD ITEM	SAP ITEM ID	PS ITEM ID
4	UL15A	9310081	9201248
2	UL15B	9310082	9201247
1/0	UL15C	9310080	9201249
2/0	UL15D	9310079	9201250
4/0	UL15E	9310086	9201251
350	UL15K	9310097	9201252
500 / 500 comp	UL15M	9310106	9201253
500 – 4 hole	UL15M4	9389616	n/a
500 Stackable Lug	UL15MS	9306510	9201699
600	UL15N	9310098	9201254
750	UL15P	9310114	9201255
1000 - 2 hole	UL15R	9310227	9201256
1000 - 4 hole	UL15R4	9310085	9201244

[1]This Item appears in other CUs
[2]This CU contains additional items needed for installation per standards
[3]This item has a CU with labor/material and a CU with material only

LUG, TERMINAL, ALUMINUM

Tinned aluminum lug with NEMA 2 or 4 hole pad (9/16" holes @ 1 3/4" spacing). Lugs are sealed to prevent water intrusion into the cable. For use on aluminum cable terminations. See Section 34 for die / crimping information.

SIZE AWG / kcmil	STD ITEM	SAP ITEM ID	PS ITEM ID
4	UL16A	9310225	9201258
2	UL16B	9310226	9201257
1/0	UL16C	9310224	9201259
2/0	UL16D	9310223	9201260
4/0	UL16E	9310222	9201261
350	UL16K	9310221	9201262
500	UL16M	9310220	9201263
600	UL16N	9310199	9201264
750	UL16P	9310198	9201265
1000 - 2 holes	UL16R	9310197	9201266
1000 - 4 hole	UL16R4	9310083	9201246

[1]This Item appears in other CUs
[2]This CU contains additional items needed for installation per standards
[3]This item has a CU with labor/material and a CU with material only

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TAG, LETTER

⅞ inch wide x 1⅝ inch high, hot stamped polyethelene, black characters embossed on yellow background. All inks shall be treated for U.V. exposure. Use with slide in tag holder, UP21W.

LETTER	STD ITEM	SAP ITEM ID	PS ITEM ID
“A”	UP21L	9314869	0800029
“B”	UP21L	9314868	0800030
“C”	UP21L	9314867	0800031
“D”	UP21L	9314866	0800032
“E”	UP21L	9314865	0800033
“F”	UP21L	9314957	0800034
“G”	UP21L	9314864	0800035
“H”	UP21L	9314863	0800036
“I”	UP21L	9314862	0800037
“J”	UP21L	9314861	0800038
“K”	UP21L	9314860	0800039
“L”	UP21L	9314859	0800040
“M”	UP21L	9314858	0800041
“N”	UP21L	9314757	0800042
“O”	UP21L	9314756	0800043
“P”	UP21L	9314755	0800044
“Q”	UP21L	9314857	0800045
“R”	UP21L	9314856	0800046
“S”	UP21L	9314855	0800047
“T”	UP21L	9314833	0800048
“U”	UP21L	9314832	0800049
“V”	UP21L	9314831	0800050
“W”	UP21L	9314830	0800051
“X”	UP21L	9314808	0800052
“Y”	UP21L	9314807	0800053
“Z”	UP21L	9314806	0800054
“–“ (dash)	UP21L	9314805	0800055

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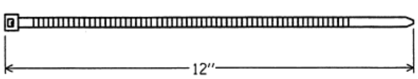
TAG, NUMBER

⅞ inch wide x 1⅝ inch high, hot stamped polyethelene, black characters embossed on yellow background. All inks shall be treated for U.V. exposure. Use with slide in tag holder, UP21W.

NUMBER	STD ITEM	SAP ITEM ID	PS ITEM ID
"0"	UP21N	9314804	0800056
"1"	UP21N	9314803	0800057
"2"	UP21N	9314802	0800058
"3"	UP21N	9314809	0800059
"4"	UP21N	9314958	0800060
"5"	UP21N	9314801	0800061
"6"	UP21N	9314799	0800062
"7"	UP21N	9314798	0800063
"8"	UP21N	9314797	0800064
"9"	UP21N	9314796	0800065
"1/2"	UP21N	9306442	9201816

CABLE TIES

12 inch long, black, high quality nylon, self locking with minimum loop tensile strength of 50 lbs. U.V. resistant. For use with tag holder, item UP21W



STD ITEM	SAP ITEM ID	PS ITEM ID
UP21T	9314871	0800027

TAG HOLDER

Tag Holder, black polyethylene, easy slide-in design. For use with items UP21L, UP21N, and UP21T

STD ITEM	DIGIT LENGTH	SAP ITEM ID	PS ITEM ID
UP21W	6	9314870	0800028
UP21W1	10	9314330	0810508
UP21W2	2	9310998	5103066

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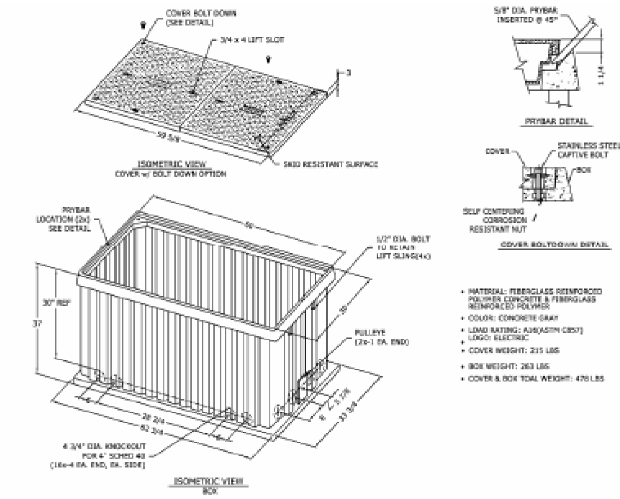
BOX, PRIMARY PULL & SPLICE, RECTANGULAR

Primary cable pull / splice box, Fiberglass, with polymer concrete cover, cable pulling eyes, and conduit knockouts. For use in conduit URD systems. In accordance with ~~National Grid~~PPL Material Specification MS 5057.



STD ITEM	SAP ITEM ID	PS ITEM ID
UR6	9309511	5640808

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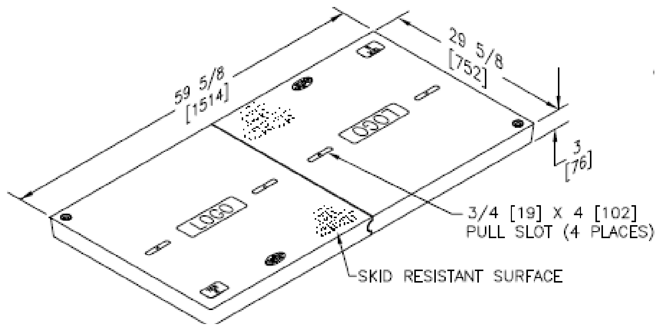
COVER, TWO PIECE, FOR PRIMARY PULL & SPLICE BOX, RECTANGULAR

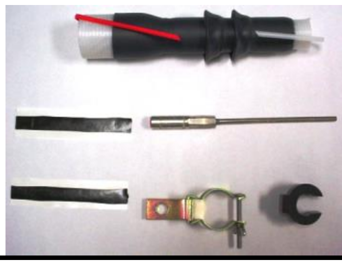
Two piece polymer concrete cover, for primary pull / splice box. For use in conduit URD systems. In accordance with ~~National Grid~~PPL Material Specification MS 5057. Cover can be used as a replacement for the one piece cover.



STD ITEM	SAP ITEM ID	PS ITEM ID
UR6C	9308054	9202714

TERMINATION, COLD SHRINK, 15 kV, #2 ONLY

Cold shrink termination designed for terminating #2 conductor, 15kV cable only. This terminator to be used on poles only. For switchgear, use item UR44B. This kit contains the pin connector and single clamp bracket for mounting the terminator to the pole bracket, item C35 or E12M.



STD ITEM	SAP ITEM ID	PS ITEM ID
UR42	9307129	9201104
UR42A Clamp Bracket Single	9387015	n/a

TERMINATION, COLD SHRINK, 5–15 kV
This item has been discontinued - use up remaining stock.

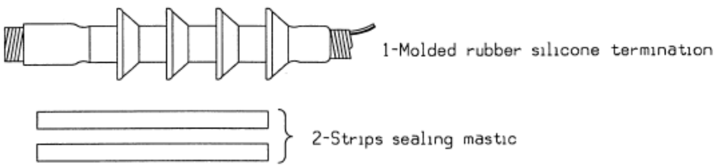
Cold shrink termination designed for terminating the following cables,

5 kV	#4/0 AWG – 400 MCM
15 kV	#2 AWG – #4/0 AWG

INSUL. O.D.RANGE	STD ITEM	SAP ITEM ID	PS ITEM ID
0.64" – 1.08"	UR43	9314094	0810502

TERMINATION, COLD SHRINK, 5-25 kV

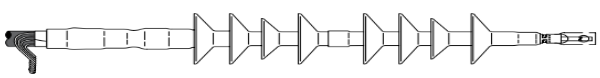
Cold shrink termination designed for terminating cables up to 25kV. Kits do not include connectors. Choose kit based on cable insulation O.D.



ORIENTATION	INSUL. O.D. RANGE	STD ITEM	SAP ITEM ID	PS ITEM ID
Upright	0.64” – 1.08”	UR44B	9314648	0810937
Upright	0.83” – 1.53”	UR44C	9303963	5643876
Upright	1.05” – 1.80”	UR44D	9314293	0810501
Upright	1.53” – 2.32”	UR44E	9303964	5643878
Inverted	0.72” – 1.29”	UR44L	9310182^{Y}	9201305^{Y}
Inverted	1.05” – 1.80”	UR44M	9310183^{Y}	9201304^{Y}

TERMINATION, COLD SHRINK, 35 kV

Cold shrink termination designed for terminating 35kV cables. Kit does not include connector. Choose kit based on cable insulation O.D.



Molded Rubber Silicone 8-skirt Termination

INSUL. O.D. RANGE	STD ITEM	SAP ITEM ID	PS ITEM ID
0.72” – 1.29”	UR45B1	9314555	0810901
1.05” – 1.80”	UR45C3	9314447	0810976
1.53” – 2.32”	UR45H	9314501	0811180

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TERMINATION, COLD SHRINK, 46 kV

Cold shrink termination designed for terminating 46kV cables. Kits do not include connectors.

Insulation OD	STD ITEM	SAP ITEM ID	PS ITEM ID
1.31 – 2.1”	UR46	9390156	N/A

CABLE POSITIONER

Aluminum bracket to attach terminator to pole bracket. Required for terminations on all cable with conductor larger that #2.

STD ITEM	SAP ITEM ID	PS ITEM ID
UR47CP	9309543	5642411

KIT, GROUNDING, TERMINATION

Accessory kit for neutral connection / grounding of cables with copper tape insulation shield. This kit is needed in addition to the cold shrink terminator, item UR43.

Insulation OD	STD ITEM	SAP ITEM ID	PS ITEM ID
0.82 – 1.63”	UR47T4	9310177	9201267

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SPLICE, COLD SHRINK, 5 – 35 Kv (DISCONTINUED)
NOTE: FOR MAINTENANCE ONLY – USE UP REMAINING STOCK

Cold Shrink splice kit for concentric neutral XLP and EPR cables, copper or aluminum conductor. Each kit contains parts for 1 single phase splice. Select proper connector from UC60 - UC63. Connector must meet dimensional requirements of splice kit. See instructions.

For aerial cable applications, replace outer jacket in splice kit with silicone jacket, Standard Item UR49D1 or UR49D3.

VOLTAGE kV	INSULATION O. D.	STD ITEM	SAP ITEM ID	PS ITEM ID
5-15	0.84-1.38”	UR49A2	9314458	0811159
35	1.07-1.70”	UR49C1	9314471	0811215
Silicone Outer Jacket for Aerial Applications		UR49D1	9314470	0811216
		UR49D3	9306802	9201658

SPLICE, PREMOLDED, 15 kV, #2 ALUMINUM

Premolded straight cable splice for two #2 AWG concentric neutral primary cables in URD applications. Use for aluminum and / or copper conductors. The kit includes a shielded splice housing, one crimp connector and silicone grease. If both cables are jacketed, cover the splice with rejacketing kit, item UR75A.

CABLE SIZE	INSULATION O.D.	STD ITEM	SAP ITEM ID	PS ITEM ID
#2	0.64" – 0.82"	UR50	9315156	0809726

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SPLICE, COLD SHRINK, 5 – 35 KV, "ALL IN ONE"

Cold Shrink splice kit for jacketed concentric neutral, flat strap and tape shield XLP and EPR cables, copper or aluminum conductor. Each kit contains parts for 1 single phase splice. The "All In One" design incorporates a silicone rubber splice body, integrated neutral sock and EPDM re-jacketing sleeve in one tube. For aerial applications the re-jacketing sleeve is UV resistant. Select proper connector from UC60 - UC63. Connector must meet dimensional requirements of splice kit. See instructions.

VOLTAGE (kV)	NOMINAL CABLE RANGE	INSULATION O. D.	STD ITEM	SAP ITEM ID
5	4/0 - 500	0.64"–1.20"	UR51A	9388525
15	#2 – 4/0	0.64"-1.20"	UR51A	9388525
15	350 - 500	0.87"-1.40"	UR51B	9388526
15	500-1000	1.03"-1.58"	UR51F	9389651
15	750 - 1000	1.28"-2.05"	UR51C	9388535
25	1/0 - 350	0.87"-1.40"	UR51B	9388526
25	500 - 1000	1.28"-2.05"	UR51C	9388535
35	1/0 – 2/0	1.03"-1.49"	UR51D	9388506
35	500 - 1000	1.36"-2.05"	UR51E	9388499

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CLAMP, SPRING

Constant force spring clamp for connecting tinned copper braid to cables with copper tape shield or lead sheath.

DIAMETER OVER SHIELD	STD ITEM	SAP ITEM ID	PS ITEM ID
0.67" – 1.14"	US1A	9311246	5105523
0.99" – 1.54"	US1B	9311244	5105524

WASHER, SQUARE FLAT, STANDARD

Galvanized steel, for normal loadings on wood; standard ⅝” or ¾” bolts (B13 or B14) per EEI Std. TDJ-10.

DIMENSION			STD ITEM	SAP ITEM ID	PS ITEM ID
O.D.	DIA. OF HOLE	THK.			
2 ¼”	13/16”	3/16”	W1	9319833	7006014
3”	13/16”	¼”	W1A	9319618	5997740
4”	13/16”	½”	W1B	9319619	5997745

WASHER, SQUARE CURVED, HEAVY

Galvanized steel large washer for heavy loading on wood using ¾” bolts. EEI – Standard TDJ-10.

DIMENSION		STD ITEM	SAP ITEM ID	PS ITEM ID
O.D.	DIA. OF HOLE			
3”	13/16”	W2	9321670	7006023
	11/16”	W2A	9306399	5997820
4”	15/16”	W3	9321674	7006009

WASHER, ROUND

Flat, galvanized steel construction, EEI Standard TDJ– 10.

DESCRIPTION	DIMENSION			STD ITEM	SAP ITEM ID	PS ITEM ID
	OUT SIDE DIA.	HOLE DIA.	THICKNESS			
Fits For use with B1	1”	7⁄16”	.083”	W5	9321579	7006001
For use with B3	1⅜”	9⁄16”	.109”	W7	9309339	7006003
For use with B13	2”	13⁄16”	.148”	W8	9321675	7006006
Fits ⅝” bolts	1 ¾”	11⁄16”	.1045”	W8A	9306405	5997445
1” Nominal Size	6”	1¼”	⅞”	W8B	9306402[E]	5997565[E]

WASHER, FLAT

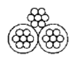
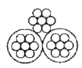
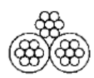
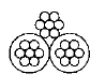
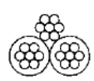
Galvanized steel, flat washer.

DIMENSION			STD ITEM	SAP ITEM ID	PS ITEM ID
O.D.	I.D.	THK.			
8”	1⁵⁄16”	½”	W8C	9306400	5997800
2¼”	13⁄16”	5⁄16”	W8D	9306401	5997790

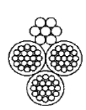
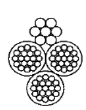
WIRE, MISCELLANEOUS

SIZE		KIND	COVERING	QUANTITY	STD ITEM	SAP ITEM ID	PS ITEM ID
#6 AWG Cu. SD.		Solid O.D. = .252" (.1620 +.09)	30 mils PE	46 lb. coil (500')	W9E	9312558	4001038
#6 AWG Cu.		CCW (6A)-3 Strand (Maintenance ONLY)	Bare		W9F	9315670[Y]	4015064[Y]
#4 AWG Cu. HD		Solid (.2043" D.)	Bare	100 lb. coil (794')	W11B	9315667[Y]	4015073[Y]
#4 AWG Cu.		CCW (4A)-3 Strand (Maintenance ONLY)	Bare		W11D	9315668[Y]	4015066[Y]
#4 AWG Cu. HD		Solid	30 mils PE	100 lb. coil (730')	W11E	9312557[Y]	4001041[Y]
#4 AWG Cu. SD		Std. OH Grounding Solid Cond. O.D. = .2943" (.2043 + .09)	45 mils PE	50 lb. coil (350')	W11F	9316528	4005640
#3 AWG Cu. HD		7 Strand Overhead Conductor. (Maintenance ONLY)	Bare	500' reel (81.5 lbs.)	W11G	9302814[E]	5943080[E]
#3 AWG Cu. HD		7 Strand (Maintenance ONLY)	45 mils PE	185lbs / 1000'	W11H	9302709	5944080
#2 AWG ACSR 6/1		7 Strand (Maintenance ONLY)	Bare Sparrow	46 lb. coil (500')	W12B	9306926[Y]	9200816[Y]
#2 AWG Cu. HD		7 Strand	Bare	500 lb. reel (2400')	W13B	9315684	4015074
#2 AWG Cu.		CCW (2A)-3 Strand (Maintenance ONLY)	Bare		W13D	9315669[Y]	4015065[Y]
#2 AWG Cu. SD		Trans. Pole & 3Ø Riser Pole Framing Cond. ~190A. 4.366 ft./lb.	45 mils PE	50 lb. coil (220')	W13E	9312556	4001042
		0.292" Dia.	Bare	60 lb. Coil (244')	W13G	9315672	4015032
#1 AWG Cu.		7 Strand (Maintenance ONLY)	Bare		W13I	9302805	5943097
		CCW 3 Strand (Maintenance ONLY)	Bare		W13J		5943093[E]
1/0 AWG Cu. HD.		7 Strand	Bare	163lb / 500'	W13K	9315933	4035253
1/0 AWG Cu. HD.		7 Strand	90 mils PE	184lb / 500'	W13L	9313369	5944107

CABLE, TRIPLEX SECONDARY AND SERVICE

SIZE		KIND	COVERING	QUANTITY	STD ITEM	SAP ITEM ID	PS ITEM ID
#2 Aluminum Triplex Service Cable		Phase (2) - #2 7 Str. 1350 AAC Neutral (1) - #2 7 Str. 6201 AAAC	45 mils XLP w/bare neutral Code – Shrimp/XLP	250' Coil (63 lbs.) 1200' reel (300lbs)	W15B	9387696 9302729	none 5940040
1/0 Aluminum Triplex Service and Secondary Cable		Phase (2) - #1/0 7 Str. 1350 AAC Neutral (1) - #1/0 7 Str. 6201 AAAC	60 mils XLP w/bare neutral Code – GAMMARUS/ XLP	200' Coil (80 lbs.) 1800' N.R. Reel	W15C	9387708 9312688	none 4003311
#4 Copper Triplex Service Cable		Phase (2) #4 7 Str. Neutral (1) - #4 7 Str. (Nantucket ONLY)	45 mils XLP w/bare neutral Code – CASLON/XLP	1000' Reel	W15F	9302001[E]	5430364[E]
#2 Copper Triplex Service Cable		Phase (2) #2 – 7 Str. Neutral (1) - #2 7 Str. (Nantucket ONLY)	45 mils XLP w/bare neutral Code – CENTURY/ XLP	1000' Reel	W15G	9301801[E]	5430356[E]
#2 Copper Triplex Secondary Cable		Phase (2) #2 – 7 Str. Neutral (1) – 1/0 7 Str. (Nantucket ONLY)	45 mils XLP w/bare neutral	1000' Reel	W15J	9307609[E]	9202446[E]

CABLE, QUADRUPLEX SECONDARY AND SERVICE

SIZE		KIND	COVERING	QUANTITY	STD ITEM	SAP ITEM ID	PS ITEM ID
1/0 Aluminum Quadruplex Service and Secondary Cable		Phase (3) #1/0 19 Str. 1350 AAC Neutral (1) - #1/0 7 Str. 6201 AAAC	60 mils/XLP w/ bare neutral Code-Shetland /XLP	1100' N.R Reel (Approx. .560 lb/ft.)	W16C	9312668	4004410
336.4 Aluminum Quadruplex Service and Secondary Cable		Phase (3) #336.4 19 Str. 1350 AAC Neutral (1) - #4/0 7 Str. 6201 AAAC	60 mils / XLP w/ bare neutral Code – Exmoor /XLP	1000' N.R. Reel (Approx. 1.509 lb/ft.)	W16E	9312646	4004436

CONDUCTOR, POLE TOP TAP

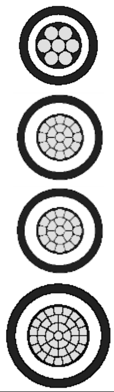
SIZE		KIND		COVERING	QUANTITY	STD ITEM	SAP ITEM ID	PS ITEM ID
2/0 Cu.		Single Conductor – 7 Sr. Cu. Med. Hard Drawn (Maintenance ONLY)		Bare	100 lb. Coil (243')	W17B	9315784[Y]	4035282[Y]
				Bare	200 lb. N.R Reel (500')	W17B	9315333	0806403
				60 mils PE	500 lb. N.R. Reel (1095')	W17C	9312555	4001043
2/0 Cu.		Single Conductor – Stranded Soft Drawn	19 Str. Cu.	Bare	50 lb Coil (120')	W17G	9310172	9201272
4/0 Alum.		Single Conductor – Stranded hard Drawn (Maintenance ONLY)	7 Str. Al.	Bare		W18B	9315759	4035219
4/0 AWG Cu.		Single Conductor - Stranded	7 Str. HD (Primary Line Wire)	Bare	100 lb. Coil (153')	W19B	9315783	4035283
					654 lb. N.R. Reel (1000')	W19B	9315352	0806404
			19 Str SD (Pole Top Wiring)	60 mils PE	500 lb. N.R. Reel (706')	W19C	9312554	4001044
			19 Str SD (Grounding Conductor)	Bare	100 lb. Coil (153')	W19G	9316038	4035019
					2000 lb. N.R. Reel (3061')	W19G	9315355	0806400

CONDUCTOR, PRIMARY BARE – 15kV-35kV

SIZE		KIND	COVERING	QUANTITY	STD ITEM	SAP ITEM ID	PS ITEM ID
1/0 (6201)		Single conductor – 7 Str. (AAAC) Standard 1Ø Primary Conductor	Bare AZUZA	6000' N.R. Reel (116lb/1000ft.)	W20A	9314544	0811017
2/0		Single conductor – 7 str. (ACSR) MAINTENANCE ONLY	Bare QUAIL	1000' N.R. Reel (124lb/1000ft.)	W21NK	9392167	N/A
336.4 kcmil		Single Conductor-19 Str. (AAC) Standard 3 Phase Primary Conductor Bare	Bare TULIP	4022' N.R. Reel (316lb/1000ft.)	W20B	9316037	4035204
477.0 kcmil		Single conductor-19 Str. (AAC) Standard 3 Phase Primary Conductor	Bare COSMOS	4245' N.R. Reel (448lb/1000ft.)	W21BA	9314655	0811125
795 kcmil		Single conductor-37 Str. (AAC) Standard 3 Phase Primary Conductor	Bare ARBUTUS	5000' Steel Reel (746lb/1000ft.)	W21BF	9302781	5941790

CONDUCTOR, PRIMARY TREE– 15 kV

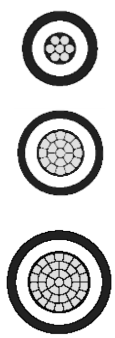
Tree conductor to be used on 15kV crossarm, armless, and spacer cable configurations per NG MS5102.



KIND	COVERING	QUANTITY	STD ITEM	SAP ITEM ID	PS ITEM ID
1/C-1/0 7Str 6201 Reg Conc Rnd	165 mils	3000' Reel (252lbs/1000ft.)	W20CA	9302832	5942105
1/C-336-19Str ECCompact	165 mils	4000' Reel (497lbs/1000ft.)	W21C	9305136	5106085
1/C-477-19Str ECCompact	160 mils	4000' Reel (633lbs/1000ft.)	W21BD	9302808	5942638
1/C-795-19Str EC Compact	180 mils	3000' Reel (1012lbs/1000ft)	W21BG	9313226[E]	5942646[E]

CONDUCTOR, PRIMARY TREE– 35 kV

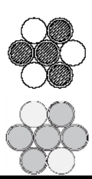
Tree conductor to be used on 35kV crossarm and spacer cable configurations per NG MS5102.



KIND	COVERING	QUANTITY	STD ITEM	SAP ITEM ID	PS ITEM ID
1/C-1/0 7Str 6201 Reg Conc Rnd	315 mils	2500' Reel (423lb/1000ft)	W21NA	9313250	5942107
1/C-477-19Str EC Compact	320 mils	3000' Reel (912lb/1000ft)	W21NB	9313248	5942639
1/C-795-19Str EC Compact	320 mils	3000' Reel (1327lb/1000ft)	W21ND	9313225	5942647

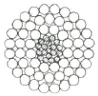
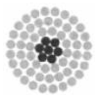
WIRE, MESSENGER, SPACER CABLE

Messenger shall be Class AA high strength alumoweld-aluminum conductors (AWAC), in accordance with requirements of ASTM B-549 and ASTM B-502.

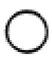
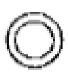


SIZE	KIND	COVERING	QUANTITY	STD ITEM	SAP ITEM ID	PS ITEM ID
1/0 – 3/4	3 Al wires, 4 Alumoweld wires	Bare	(312.6lbs/1000ft)	W21NE	9320429	5998117
1/0 – 2/5	2 Al wires, 5 Alumoweld wires	Bare	(428.0lbs/1000ft)	W21NF	9306375	5998116

CONDUCTOR, PRIMARY BARE - 35KV DISTRIBUTION SUPPLY

SIZE		KIND	COVERING	QUANTITY	STD ITEM	SAP ITEM ID	PS ITEM ID
1113 kcmil		Single conductor- 54/19 Str. (ACSR) Standard 3 Phase Primary Conductor	Bare FINCH	Per PO Reel (1431lb/1000ft.)	W21NG	9302828	5941814
795 kcmil		Single conductor- 54/7 Str. (ACSR) Standard 3 Phase Primary Conductor	Bare CONDOR	6000' R.M.T Reel (1024lb/1000ft.)	W21NH	9302831[E]	5941794[E]
477 kcmil		Single conductor 26/7 Str. (ACSR) Standard 3 Phase Primary Conductor	Bare HAWK	5785' Per Reel (656lb/1000ft.)	W21NI	9302780	5941551

TIEWIRE

SIZE		KIND	COVERING	QUANTITY	STD ITEM	SAP ITEM ID	PS ITEM ID
#6 AWG Cu. Tie Wire		Sol. Cu. SD	Bare	500' coil	W22A	9315002	4015002
#4 AWG Cu. Tie Wire		Sol. Cu. SD	Bare	792' coil	W22B	9316523	4015001
#4 AWG Al. Tie Wire		Sol. Al. SD - For Ties on Bare Alum. & ACSR	Bare	650' coil	W22C	9315703	4015201
#4 AWG Al.		Tie Wire Sol. Al. SD O.D. .30", 0.053 lb./ft For Ties on All Covered Primary Conductor with HDPE (Polymer) Pin Insulator (I6P)	45 mils TPR	500' coil	W22D	9314472	0811214

CABLE, 5KV 1/C NON-SHIELDED MEDIUM VOLTAGE - COPPER

5000V insulated softdrawn copper.

AWG SIZE	DIA OF Cu ONLY	COVERING	*AMPACITIES		STD. SHIPPING LENGTH	STD ITEM	SAP ITEM ID	PS ITEM ID
			BURIED	IN AIR				
#6 solid	.1620"	110 mils black PE	65	95	2500'	W33A	9316531	4005323
#2 7 str,	.292"	125 mils insulation 80 mils jacket	115	170	1000' (.46 lbs / ft.)	W33B	9316530	4005324
4/0 – 19 str.	.528"	125 mils insulation 95 mils jacket	230	360	1000' (.72 lbs / ft)	W33C	9315700	4020111

**Ampacities (from NEC) are for Insulated copper conductors at 75°C and 30°C ambient temperatures.*

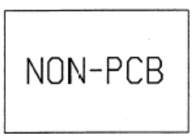
SIGNS, "PCB" WARNING

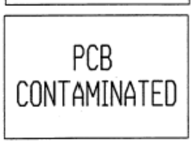
Black on yellow background. In accordance with Federal Register Vol. 43, No. 34 (Mark I) dated February 17, 1978.

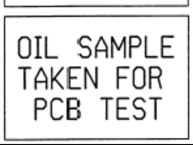
DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
CLASS II 6" X 6" Flexible sign for field attachment to wood pole with a PCB filled capacitor.	Z5	9319940[Y]	8002300[Y]
CLASS III 6" X 6" Self sticking for shop attachment to PCB filled capacitors.	Z6	9319939	8002301
CLASS III 2" X 2" Self Sticking for shop attachments to PCB filled capacitors.	Z7	9319938[Y]	8002302[Y]

SIGNS, "PCB" INFORMATION

Self Sticking Vinyl 3" Wide X 2" High.



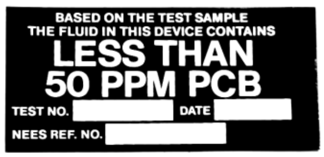




DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
"NON-PCB" White on Blue	Z8	9319944[Y]	8002296[Y]
"PCB CONTAMINATED" White on Green	Z9	9319943[Y]	8002297[Y]
"OIL SAMPLE TAKEN FOR PCB TEST" Black on White	Z10	9319942[Y]	8002298[Y]

MARKER – BLUE WITH GREY LETTERING

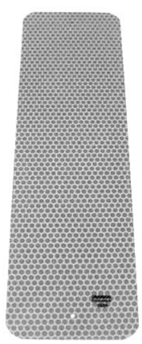
Blue marker with grey lettering measures 4½” X 2”, aluminum foil less than 50 PPM-PCB.



DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
Aluminum foil less than 50 PPM-PCB	Z11A	9318679[E]	5467249[E]
Vinyl retro-filled with non-PCB dielectric fluid.	Z11B	9318678[E]	5467250[E]

REFLECTORS, WOOD POLE AND METAL/FIBERGLASS POLE

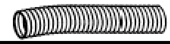
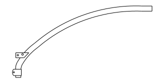
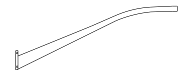
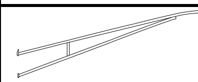
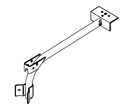
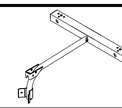
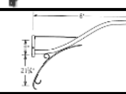
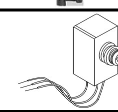
3” X 10”, 3M, 3800 series high intensity reflective acrylic and polyester film pole reflectors.

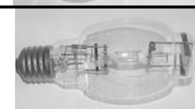
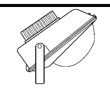


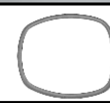
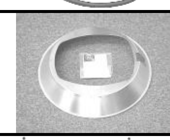
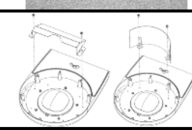
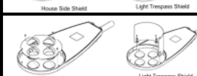
DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
White reflective marker for wood poles, 3003 alloy backing.	Z12A	9318597[E]	5480420[E]
White reflective marker for metal/fiberglass poles, backslit removable polyethylene liner.	Z12B	9309448	5480425
Yellow reflective marker for wood poles, 3003 alloy backing.	Z12C	9309505[E]	5480430[E]
Yellow reflective marker for metal/fiberglass poles, backslit removable polyethylene liner.	Z12D	9309507	5480435

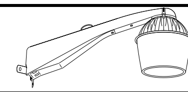
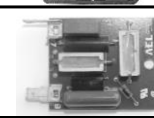
Footnotes Used in the Distribution Standards Material Catalogs

An “E” at the end of an Item ID indicates that the item is currently available in Rhode Island. A “Y” at the end of an Item ID indicates that the item was formerly in use in jurisdictions outside of Rhode Island.

MATERIAL	STD ITEM	ILLUSTRATION
• **Connectors - Conduit**		
○ Connector	C7AA	
○ Conduit Flexible – ½” PVC	C29A	
• **Brackets – Wood Pole**		
○ Street Light for Wood Pole	SB04 – SB08	
○ Street Light for Wood Pole – Heavy Duty	SB06A – SB08A	
○ Street Light for Wood Pole – Truss Style	SB10 – SB20	
○ Flood Light for Wood Pole – Single	SB30	
○ Flood Light for Wood Pole – Twin	SB31	
○ “Fairview” – Decorative for Wood Pole	SB40	
○ “Park Ave. South” – Decorative for Wood Pole	SB42	
• **Controls – Photoelectric**		
○ Photoelectric – Twistlock	SC01 – SC04	
○ Photoelectric - Button	SC17	
○ Receptacle Caps - Twistlock	SC20 – SC21	
○ Receptacle – Twistlock Photoelectric	SC30	
○ PEC Visor	SC31	

MATERIAL	STD ITEM	ILLUSTRATION
○ **Lamps**		
○ Incandescent	SH01	
○ Mercury Vapor	SH02C – SH02K	
○ High Pressure Sodium Vapor	SH03A – SH03G2	
○ Metal Halide	SH04E – SH05H	
● **Luminaires - Setback**		
○ High Pressure Sodium Vapor	SI03G – SI03H	
○ **Luminaires - Floodlight**		
○ High Pressure Sodium Vapor	SJ03B – SJ03K	
○ Metal Halide	SJ04K – SJ05H	
○ Light Emitting Diode – LED	SJ06E– SJ06F	
○ **Accessories & Replacement Parts**		
○ GE – P154 Floodlight Luminaires	SJ10A – SJ10D	
○ GE – PF154 Floodlight Luminaires	SJ11A – SJ11D	
○ GE – PF400 Floodlight Luminaires	SJ12A – SJ12D	
○ GE – PF1000 Floodlight Luminaires	SJ13A – SJ13D	
○ Cooper – CFB Floodlight Luminaires	SJ20A – SJ20D	

MATERIAL	STD ITEM	ILLUSTRATION
○ Cooper – GPF Floodlight Luminaires	SJ21A – SJ21D	
• **Luminaires – Horizontal Roadway**		
○ High Pressure Sodium Vapor – Semi-Cutoff	SK03A – SK03K	
○ High Pressure Sodium Vapor – Cutoff	SK03A1 – SK03H1	
○ Metal Halide – Semi-Cutoff	SK05H	
○ Light Emitting Diode – (LED)	SK06A – SK06H	
○ High Pressure Sodium Vapor – 240 VAC	SK10C1 – SK10G	
○ High Pressure Sodium Vapor – 277 VAC	SK20C – SK20H	
• **Accessories & Replacement Parts**		
○ Semi-Cutoff Refractors	SK50A1 – SK50B2	
○ Security Refractor for LED Roadway	SK51	
○ Cutoff Flat Glass Lens	SK60A3 – SK60B4	
○ 360° External Light Trespass Shield	SK70	
○ House Shield & Light trespass shield – LED For STD Items SK06A1,SK06A and SK06C	SK70A – SK70B	
○ House Shield & Light trespass shield – LED For STD Item SK06G	SK70C – SK70D	
○ House Shield & Light trespass shield – LED For STD Item SK06H	SK70E – SK70F	
○ Bird Guard	SK71	
○ Capacitor	SK80A – SK80B	

MATERIAL	STD ITEM	ILLUSTRATION
• **Luminaires – Security**		
○ Residential – Powerbracket	SN03C	
○ Optical Assembly	SN10	
• **Luminaires – Teardrop**		
○ “Delaware Park” Roadway Teardrop Luminaires	SP10D – SP12H2	
○ “Delaware Park” Roadway Teardrop Luminaires Replacement Parts	SP10W1 – SP10Z2	
○ “Westminster” - LED	SP20CB – SP30CG	
• **Luminaires – Accessories & Replacement Parts**		
○ NEMA Wattage Labels	SR03A1 – SR05H	
○ Luminaire Ownership Label	SR11	
○ HPS Starters – GE Lighting Systems	SR20A – SR20G	
○ HPS Starters – Cooper Lighting	SR21A – SR21C	
○ HPS Starters – American Electric Lighting	SR22A – SR22D	
○ HPS Starters – Holophane	SR23A – SR23B	
• **Wire & Cable – Outdoor Lighting**		
○ Luminaire Supply Conductors – #10 AWG	SY4A2	

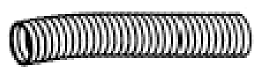
CONNECTOR - OVERHEAD

Connector, street light, aluminum, parallel groove, non-tension, used to connect #10 AWG stranded copper street light fixture wire to #1/0 AWG aluminum secondary conductor. Use with STD Item C60R cover.

STD ITEM	SAP ITEM ID	PS ITEM ID
C7AA	9306443	9201815

CONDUIT – FLEXIBLE PVC

½" grey PVC flexible conduit. Used for mechanical protection of #10 AWG luminaire supply conductors on all wood pole streetlight and floodlight installations.

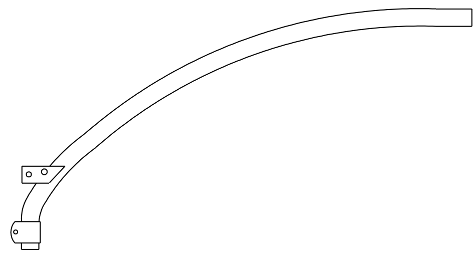


STD ITEM	SAP ITEM ID	PS ITEM ID
C29A	9306805	9201925

BRACKET – STREET LIGHT FOR WOOD POLE

Upsweep pipe style, aluminum, 2” diameter schedule 40 pipe, 2” NPS slipfitter. Requires 12” of pole space. Mounting hardware = (1) 5/8” thru-bolt and (2) ½” x 4” lag screws. In accordance with PPL Material Specification Standard MS-6310.

Approximate Weight
4’ bracket = 8 pounds
6’ bracket = 11 pounds
8’ bracket = 15 pounds



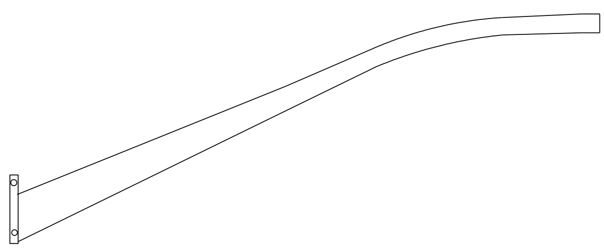
Note: The 8-foot bracket has a ¾” diameter aluminum pipe underbrace.

BRACKET LENGTH	USE	STD ITEM	SAP ITEM ID	PS ITEM ID
4 Foot	50 W – 400 W roadway luminaires	SB04	9310697	5820352
6 Foot	50 W – 250 W roadway luminaires	SB06	9314574	0811030
8 Foot	50 W – 250 W roadway luminaires	SB08	9314575	0811029

BRACKET – STREET LIGHT FOR WOOD POLE – HEAVY DUTY

Tapered elliptical style, aluminum, 2” NPS slipfitter. Requires 12” of pole space. Mounting hardware = (1) 5/8” thru-bolt and (2) ½” x 4” lag screws. In accordance with PPL Material Specification Standard MS-6310.

Approximate Weight
6’ bracket = 13 pounds
8’ bracket = 18 pounds

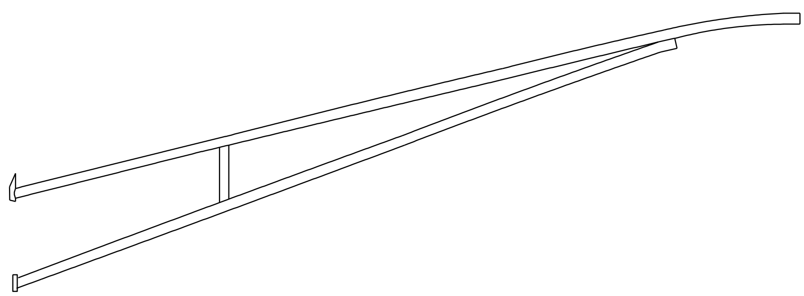


BRACKET LENGTH	USE	STD ITEM	SAP ITEM ID	PS ITEM ID
6 Foot	400 W & 1,000 W roadway luminaires	SB06A	9317630	5820378
8 Foot	400 W & 1,000 W roadway luminaires	SB08A	9310695	5820379

BRACKET – STREET LIGHT FOR WOOD POLE

Tapered truss style, aluminum, 2” NPS slip-fitter. Requires 24” of pole space. Mounting hardware = (1) 5/8” thru-bolt and (4) ½” x 4” lag screws. In accordance with PPL Material Specification Standard MS-6310.

Approximate Weight
10’ bracket = 35 pounds
12’ bracket = 41 pounds
16’ bracket = 58 pounds
20’ bracket = 89 pounds

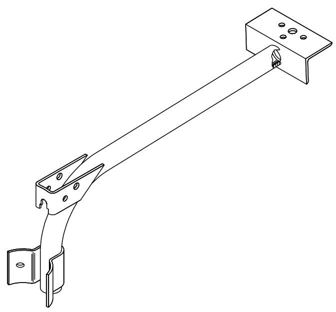


BRACKET LENGTH	USE	STD ITEM	SAP ITEM ID	PS ITEM ID
10 Foot	50 W – 400 W roadway luminaires	SB10	9309600	5820487
12 Foot	50 W – 400 W roadway luminaires	SB12	9309601	5820468
16 Foot	50 W – 400 W roadway luminaires	SB16	9310694	5820563
20 Foot	50 W – 400 W roadway luminaires	SB20	9307225[Y]	9200483[Y]

BRACKET – FLOOD LIGHT FOR WOOD POLE – SINGLE

30” length, aluminum, 2” diameter schedule 40 pipe. Use to mount one floodlight luminaire. Requires 12” of pole space. Mounting hardware = (1) 5/8” thru-bolt and (2) ½” x 4” lag screws. In accordance with PPL Material Specification Standard MS-6320.

Approximate Weight = 14 pounds.

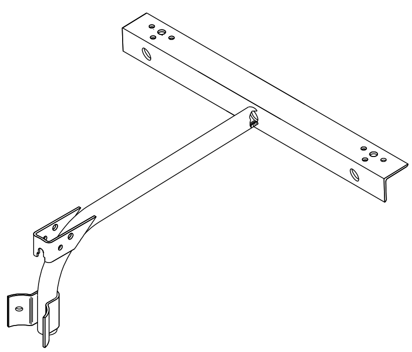


STD ITEM	SAP ITEM ID	PS ITEM ID
SB30	9314576	0811027

BRACKET – FLOOD LIGHT FOR WOOD POLE – TWIN

30” length, aluminum, 2” diameter schedule 80 pipe. Requires 12” of pole space. Mounting hardware = (1) 5/8” thru-bolt and (2) ½” x 4” lag screws. Use to mount two floodlight luminaires on the same bracket. In accordance with PPL Material Specification Standard MS-6320.

Approximate Weight = 26 pounds.



STD ITEM	SAP ITEM ID	PS ITEM ID
SB31	9314573	0811032

"FAIRVIEW" BRACKET – FOR WOOD POLE

Decorative bracket, 30" length, aluminum, 2" diameter schedule 40 pipe, color: BLACK, 3"-tenon. Use to mount a post top style luminaire on a wood pole. Requires 16" of pole space. Mounting hardware = (1) 5/8" thru-bolt and (2) ½" x 4" lag screws.

CLOSED OFFERING – Use is limited to maintenance of existing installations only.

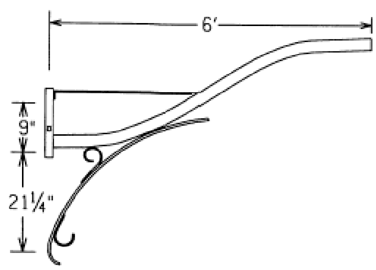
Approximate Weight = 17 pounds.

STD ITEM	SAP ITEM ID	PS ITEM ID
SB40	9309714[E]	5821495[E]

"PARK AVE SOUTH" BRACKET – FOR WOOD POLE

Decorative bracket, 6' length, aluminum, 2" diameter schedule 80 pipe, color: BLACK, for use with teardrop style luminaires. Requires 36" of pole space. Mounting hardware = (2) 5/8" thru-bolt and (1) ½" x 4" lag screw.

Approximate Weight = 22 pounds.



STD ITEM	SAP ITEM ID	PS ITEM ID
SB42	9314442[Y]	0810983[Y]

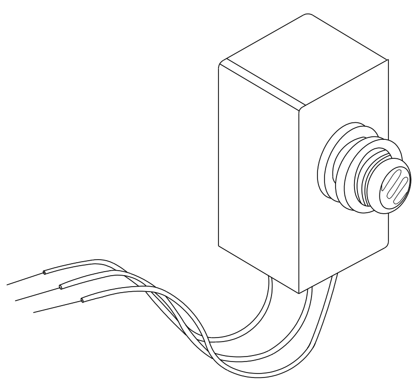
CONTROL – PHOTOELECTRIC – TWISTLOCK

Solid state electronic, 1,000 W lamp load. 1½ foot-candle "turn-on" value, 2 – 5 second time delay on "turn off". In accordance with PPL Material Specification Standard MS-6140.

	HOUSING COLOR	STD ITEM	SAP ITEM ID	PS ITEM ID
105 – 130 VAC *(Use on all 120VAC HID luminaires)*	GREY	SC01	9314677	0811055
105 – 300 VAC – Long Life *(Use on 240 VAC & 277 VAC HID luminaires)* *(Use on all LED luminaires)*	BLUE	SC02	9314675	0811057
105 – 130 VAC – Part Night *(For use in New Hampshire only)*	GREEN	SC04	9314766[E]	9202661[E]

CONTROL – PHOTOELECTRIC – BUTTON

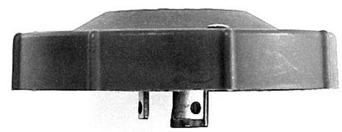
105-130 VAC, 500 W lamp load, 1½ foot-candle "turn-on" value, 5 – 10 second time delay on "turn off", with 3-12" long, #18 AWG, stranded copper leads, color coded: black=source, white=neutral, red=load. In accordance with PPL Material Specification Standard MS-6141.



STD ITEM	SAP ITEM ID	PS ITEM ID
SC17	9311605	2501701

CONTROL – RECEPTACLE CAPS – TWISTLOCK

Use in place of the twistlock photoelectric control to leave lamp load either permanently "ON" or "OFF". 1,000 W lamp load, In accordance with PPL Material Specification Standard MS-6140.



	HOUSING COLOR	STD ITEM	SAP ITEM ID	PS ITEM ID
OPEN Receptacle Cap *(Leave lamp load "OFF")*	RED	SC20	9311953	2505407
SHORTING Receptacle Cap *(Leave lamp load "ON")*	BLACK	SC21	9314674	0811058

RECEPTACLE – TWISTLOCK – FOR PHOTOELECTRIC CONTROL

For mounting twist-lock photo control directly to pole, crossarm, or to ½" threaded conduit. With three 18" long #14 AWG (minimum) stranded copper leads, color coded: black=source, white=neutral, red=load.

STD ITEM	SAP ITEM ID	PS ITEM ID
SC30	9311954	2505403

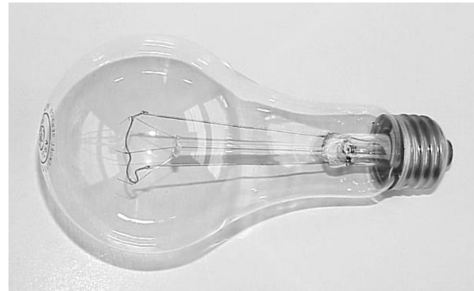
VISOR – FOR PHOTOELECTRIC CONTROL

Accessory for use with photoelectric control to prevent false control operation due to stray light interference. Black aluminum visor with stainless steel mounting strap.

STD ITEM	SAP ITEM ID	PS ITEM ID
SC31	9306309	9202075

LAMP – INCANDESCENT

Filament, 125 VAC, medium screw base, clear bulb, 6,000 hour rated life. In accordance with PPL Material Specification Standard MS-6132.



LAMP WATTAGE	AVERAGE INITIAL LUMENS	STD ITEM	SAP ITEM ID	PS ITEM ID
189 or 202 or 205	2,750	SH01F	9319567	9001959

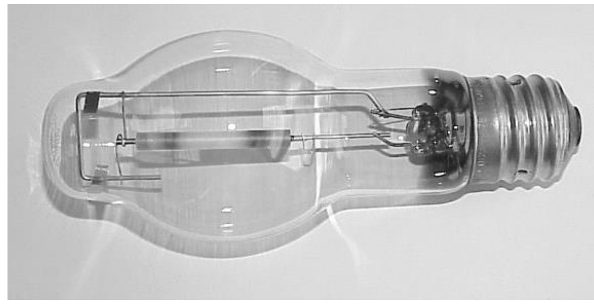
LAMP – MERCURY VAPOR

High intensity discharge, mogul screw base, phosphor coated bulb, 24,000 hour rated life. In accordance with PPL Material Specification Standard MS-6133.

LAMP WATTAGE	ANSI LAMP CODE	AVERAGE INITIAL LUMENS	STD ITEM	SAP ITEM ID	PS ITEM ID
100	H38	4,400	SH02C	9311927	2505324
175	H39	8,500	SH02E	9311940	2505357
250	H37	13,000	SH02G	9314788	0801051
400	H33	23,000	SH02H	9311928	2505319
1,000	H36	63,000	SH02K	9311957	2505361

LAMP – HIGH PRESSURE SODIUM VAPOR

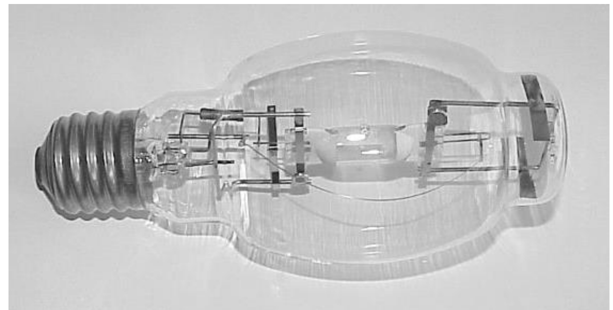
High intensity discharge, mogul screw base, clear bulb, non-cycling, 30,000 hour rated life. In accordance with PPL Material Specification Standard MS-6134.



LAMP WATTAGE	ANSI LAMP CODE	AVERAGE INITIAL LUMENS	STD ITEM	SAP ITEM ID	PS ITEM ID
50	S68	4,000	SH03A	9321158[E]	5824615[E]
70	S62	6,300	SH03B	9313585	2508070
100	S54	9,500	SH03C	9313602	2508100
150	S55	16,000	SH03D	9313604	2508150
250	S50	28,500	SH03G	9313605	2508250
400	S51	50,000	SH03H	9313622	2508400
1,000	S52	140,000	SH03K	9313621	2508900

LAMP – METAL HALIDE
PROBE START

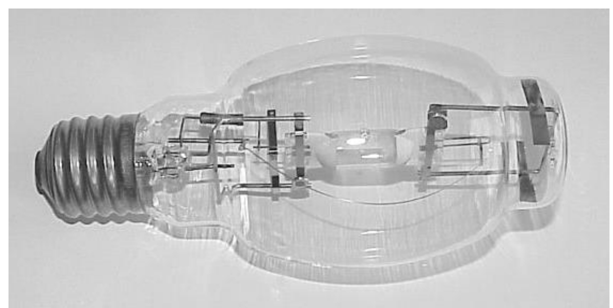
High intensity discharge, mogul screw base, clear bulb. In accordance with PPL Material Specification Standard MS-6135.



LAMP WATTAGE	ANSI LAMP CODE	VERTICAL BURNING POSITION AVG. INITIAL LUMENS	VERTICAL BURNING POSITION RATED LIFE (hours)	HORIZONTAL BURNING POSITION AVG. INITIAL LUMENS	HORIZONTAL BURNING POSITION RATED LIFE (hours)	STD ITEM	SAP ITEM ID	PS ITEM ID
175	M57	14,400	10,000	12,800	7,500	SH04E	9316214	1577025
250	M58	22,000	10,000	20,000	6,000	SH04G	9314795	0800075
400	M59	36,000	20,000	32,000	15,000	SH04H	9314726	0801867
1,000	M47	110,000	15,000	107,800	9,000	SH04K	9316259	1571762

LAMP – METAL HALIDE
PULSE START

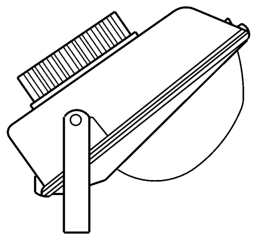
High intensity discharge, mogul screw base, clear bulb. In accordance with PPL Material Specification Standard MS-6135.

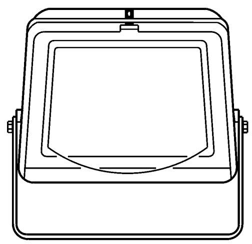


LAMP WATTAGE	ANSI LAMP CODE	VERTICAL BURNING POSITION AVG. INITIAL LUMENS	VERTICAL BURNING POSITION RATED LIFE (hours)	HORIZONTAL BURNING POSITION AVG. INITIAL LUMENS	HORIZONTAL BURNING POSITION RATED LIFE (hours)	STD ITEM	SAP ITEM ID	PS ITEM ID
175	M152	14,400	15,000	12,000	12,000	SH05E	9306259	9202096
250	M153	22,000	15,000	19,000	12,000	SH05G	9306258	9202097
400	M155	36,000	20,000	31,000	15,000	SH05H	9306257	9202098

SETBACK LUMINAIRE – HIGH PRESSURE SODIUM VAPOR

HID, Grey Housing, PEC Receptacle, Trunnion Mounted.





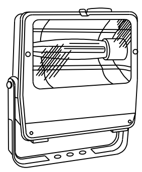
Approximate Weight
250w = 60 pounds
400w = 60 pounds

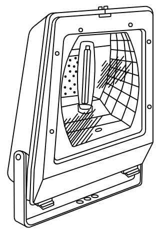
Note 1: STD ITEM SI03G and SI03H are a CLOSED OFFERING. Stock is available for maintenance of existing installations only.

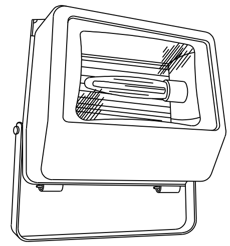
	WATTAGE	BALLAST	STD ITEM	SAP ITEM ID	PS ITEM ID
120 volt	250 W	Regulated	SI03G	9387236[Y]	none
120 volt	400 W	Regulated	SI03H	9387237[Y]	none

FLOODLIGHT LUMINAIRE – HIGH PRESSURE SODIUM VAPOR

HID, Grey Housing, PEC Receptacle, In accordance with PPL Material Specification Standard MS-6220.


70 W & 150 W


250 W & 400 W


1,000 W

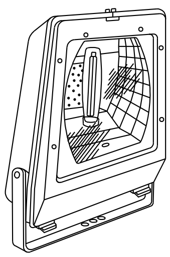
Approximate Weight
70w = 25 pounds
150w = 25 pounds
250w = 45 pounds
400w = 45 pounds
1000w = 65 pounds

Note 1: STD ITEM SJ03K is a CLOSED OFFERING. Stock is available for maintenance of existing installations only.

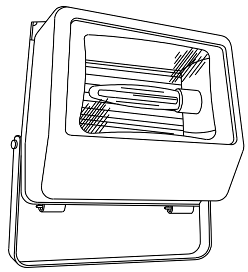
	WATTAGE	BALLAST	STD ITEM	SAP ITEM ID	PS ITEM ID
120 volt	70 W	Reactor	SJ03B	9305871[E]	5107009[E]
120 volt	150 W	Reactor	SJ03D	9305870[E]	5107011[E]
120 volt	250 W	Regulated	SJ03G	9314672	0811060
120 volt	400 W	Regulated	SJ03H	9314671	0811061
277 volt	400 W	Regulated	SJ03H1	9306198	9201855
(see note 1) - 120 volt	1,000 W	Regulated	SJ03K	9314670	0811062

FLOODLIGHT LUMINAIRE – METAL HALIDE

HID, Grey Housing, PEC Receptacle, In accordance with PPL Material Specification Standard MS-6220.



250 W & 400 W



1,000 W

Approximate Weight
250w = 45 pounds
400w = 45 pounds
1000w = 65 pounds

Note 1: 250 watt probe start metal halide floodlights have been discontinued with no replacement luminaire provided. When replacement of existing in service 250 watt metal halide floodlights is required, they shall be converted to 400w pulse start metal halide. Billing changes to customer apply.

Note 2: STD ITEM SJ04K is a CLOSED OFFERING. Stock is available for maintenance of existing installations only.

	WATTAGE	BALLAST	STD ITEM	SAP ITEM ID	PS ITEM ID
(see note 2) - 120 volt	1,000 W	Regulated	SJ04K	9314669	0811063
120 volt	400 W PSMH	Regulated	SJ05H	9306795	9202149

FLOODLIGHT LUMINAIRE – LIGHT EMITTING DIODE (LED)

LED, Grey Housing, PEC Receptacle, In accordance with PPL Material Specification Standard MS-6221.

SJ06E

Approximate Weight
150 W – 28 pounds
275 W – 40 pounds

SJ06F

	MAXIMUM WATTAGE	DELIVERED LUMENS	STD ITEM	SAP ITEM ID	PS ITEM ID
120/277 volt	150W	14,000-20,000	SJ06E	9393538	N/A
120/277 volt	199W	20,000-30,000	SJ06F	9393537	N/A

FLOODLIGHT ACCESSORIES AND REPLACEMENT PARTS
GE LIGHTING SYSTEMS - P154 FLOODLIGHT LUMINAIRES

	STD ITEM	SAP ITEM ID	PS ITEM ID
Front door and tempered glass lens assembly - GREY	SJ10A	9305884	5107021
Vandal shield – Wire Guard	SJ10B	*future item*	*future item*
Vandal shield - Polycarbonate	SJ10C	9305270	5106595
Visor – Aluminum, Top & two side	SJ10D	9305284	5106597

FLOODLIGHT ACCESSORIES AND REPLACEMENT PARTS
GE LIGHTING SYSTEMS - PF154 FLOODLIGHT LUMINAIRES

	STD ITEM	SAP ITEM ID	PS ITEM ID
Front door and tempered glass lens assembly - GREY	SJ11A	*future item*	*future item*
Vandal shield – Wire Guard	SJ11B	*future item*	*future item*
Vandal shield - Polycarbonate	SJ11C	*future item*	*future item*
Visor – Aluminum, Top & two side	SJ11D	*future item*	*future item*

FLOODLIGHT ACCESSORIES AND REPLACEMENT PARTS
GE LIGHTING SYSTEMS – PF400 FLOODLIGHT LUMINAIRES

	STD ITEM	SAP ITEM ID	PS ITEM ID
Front door and tempered glass lens assembly - GREY	SJ12A	9309599	5820905
Vandal shield – Wire Guard	SJ12B	*future item*	*future item*
Vandal shield - Polycarbonate	SJ12C	9317662	5825811
Visor – Aluminum, Top & two side	SJ12D	9317640	5825814

FLOODLIGHT ACCESSORIES AND REPLACEMENT PARTS
GE LIGHTING SYSTEMS – PF1000 FLOODLIGHT LUMINAIRES

	STD ITEM	SAP ITEM ID	PS ITEM ID
Front door and tempered glass lens assembly - GREY	SJ13A	*future item*	*future item*
Vandal shield – Wire Guard	SJ13B	*future item*	*future item*
Vandal shield - Polycarbonate	SJ13C	*future item*	*future item*
Visor – Aluminum, Top & two side	SJ13D	*future item*	*future item*

FLOODLIGHT ACCESSORIES AND REPLACEMENT PARTS
COOPER LIGHTING – CFB FLOODLIGHT LUMINAIRES

	STD ITEM	SAP ITEM ID	PS ITEM ID
Front door and tempered glass lens assembly - GREY	SJ20A	9306324	9201363
Vandal shield – Wire Guard	SJ20B	9306326	9201361
Vandal shield - Polycarbonate	SJ20C	*future item*	*future item*
Visor – Aluminum, Top & two side	SJ20D	9306325	9201362

FLOODLIGHT ACCESSORIES AND REPLACEMENT PARTS
COOPER LIGHTING – GPF FLOODLIGHT LUMINAIRES

	STD ITEM	SAP ITEM ID	PS ITEM ID
Front door and tempered glass lens assembly - GREY	SJ21A	*future item*	*future item*
Vandal shield – Wire Guard	SJ21B	*future item*	*future item*
Vandal shield - Polycarbonate	SJ21C	*future item*	*future item*
Visor – Aluminum, Top & two side	SJ21D	*future item*	*future item*

HORIZONTAL ROADWAY LUMINAIRE
HIGH PRESSURE SODIUM VAPOR – SEMI-CUTOFF

HID, High Pressure Sodium Vapor, 120 VAC, IES Medium, Semi-Cutoff, GREY housing, PECR, with 1-1/4” to 2” slip-fitter, In accordance with PPL Material Specification Standard MS-6210.

Note 2: STD ITEM SK03K is a CLOSED OFFERING. Stock is available for maintenance of existing installations only.

Approximate Weight
50w – 150w reactor = 14 pounds
70w – 150w regulated = 30 pounds
250w = 27 pounds
400w = 39 pounds
1,000w = 76 pounds

WATTAGE	BALLAST	IES LIGHT DISTRIBUTION	REFRACTOR	STD ITEM	SAP ITEM ID	PS ITEM ID
50 W	Reactor	Type II	Prismatic Acrylic	SK03A	9309606[E]	5821438[E]
70 W	Reactor	Type II	Prismatic Acrylic	SK03B	9314688	0811068
100 W	Reactor	Type II	Prismatic Acrylic	SK03C	9314705	0811069
150 W	Reactor	Type II	Prismatic Acrylic	SK03D	9314704	0811070
250 W	Regulated	Type III	Prismatic Glass	SK03G	9314703	0811071
400 W	Regulated	Type III	Prismatic Glass	SK03H	9313589	2507400
(see note 2) - 1,000 W	Regulated	Type III	Prismatic Glass	SK03K	9314701	0811073

HORIZONTAL ROADWAY LUMINAIRE
HIGH PRESSURE SODIUM VAPOR – CUTOFF

HID, High Pressure Sodium Vapor, 120 VAC, IES Medium, Cutoff, GREY housing, PECR, with 1-1/4” to 2” slip-fitter, In accordance with PPL Material Specification Standard MS-6210.

Approximate Weight
50w – 250w = 30 pounds
400w = 39 pounds

WATTAGE	BALLAST	IES LIGHT DISTRIBUTION	REFRACTOR	STD ITEM	SAP ITEM ID	PS ITEM ID
50 W	Reactor	Type III	Flat Tempered Glass	SK03A1	9309717[E]	5821440[E]
70 W	Reactor	Type III	Flat Tempered Glass	SK03B1	9315139	0810168
100 W	Reactor	Type III	Flat Tempered Glass	SK03C1	9314656	0811065
150 W	Reactor	Type III	Flat Tempered Glass	SK03D1	9314687	0811066
250 W	Regulated	Type III	Flat Tempered Glass	SK03G1	9314706	0811067
400 W	Regulated	Type III	Flat Tempered Glass	SK03H1	9314700	0811074

HORIZONTAL ROADWAY LUMINAIRE
PULSE START METAL HALIDE – SEMI-CUTOFF

HID, Pulse Start Metal Halide, 120 VAC, IES Medium, Semi-cutoff, GREY housing, PECR, with 1-1/4" to 2" slip-fitter, In accordance with PPL Material Specification Standard MS-6210.

Approximate Weight = 39 pounds.

WATTAGE	BALLAST	IES LIGHT DISTRIBUTION	REFRACTOR	STD ITEM	SAP ITEM ID	PS ITEM ID
400 W PSMH	Regulated	Type III	Prismatic Glass	SK05H	9306796Y	9202148Y

HORIZONTAL ROADWAY LUMINAIRE
LIGHT EMITTING DIODE – (LED)

LED, 120-277 VAC, IES type II or III, 4000K LED color temperature, GREY housing, PECR, dimming capable, with 1-1/4" to 2" slip-fitter, In accordance with PPL Material Specification Standard MS-6211.

Approximate Weight
20W – 48W = 12 pounds.
96W = 21 pounds
275W = 30 pounds

IES DISTRIBUTION	MAXIMUM SYSTEM WATTAGE (Watts)	DELIVERED LUMEN OUTPUT RANGE (Lumens)	STD ITEM	SAP ITEM ID	PS ITEM ID
Type II	20	Up to 2,000	SK06A1	9390299	N/A
Type II	25	2,001 – 4,000	SK06A	9389768	N/A
Type II	48	4,001 – 8,000	SK06C	9389795	N/A
Type III	96	8,001 – 14,000	SK06G	9389786	N/A
Type III	210	20,000 – 30,000	SK06H	9389785	N/A

HORIZONTAL ROADWAY LUMINAIRE
HIGH PRESURE SODIUM VAPOR – 240 VAC

HID, High Pressure Sodium Vapor, 240 VAC – 2-wire source, IES Medium, Cutoff, GREY housing, PECR, with 1-1/4" to 2" slip-fitter, In accordance with PPL Material Specification Standard MS-6210.

(Rhode Island only)

Approximate Weight = 30 pounds.

WATTAGE	BALLAST	IES LIGHT DISTRIBUTION	REFRACTOR	STD ITEM	SAP ITEM ID	PS ITEM ID
100 W	Regulated	Type III	Flat Tempered Glass	SK10C1	9310320[E]	9201152[E]

HORIZONTAL ROADWAY LUMINAIRE
HIGH PRESURE SODIUM VAPOR – 240 VAC

HID, High Pressure Sodium Vapor, 240 VAC – 2-wire source, IES Medium, Semi-cutoff, GREY housing, PECR, with 1-1/4" to 2" slip-fitter, In accordance with PPL Material Specification Standard MS-6210.

(Route 295 – Providence, RI)

Approximate Weight = 30 pounds.

WATTAGE	BALLAST	IES LIGHT DISTRIBUTION	REFRACTOR	STD ITEM	SAP ITEM ID	PS ITEM ID
250 W	Regulated	Type III	Prismatic Glass	SK10G	9321187[E]	5821524[E]

HORIZONTAL ROADWAY LUMINAIRE
HIGH PRESURE SODIUM VAPOR – 277 VAC

HID, High Pressure Sodium Vapor, 277 VAC – 2-wire source, IES Medium, Semi-cutoff, GREY housing, PECR, with 1-1/4" to 2" slip-fitter, In accordance with PPL Material Specification Standard MS-6210.

Approximate Weight
100w – 250w = 30 pounds
400w = 39 pounds

WATTAGE	BALLAST	IES LIGHT DISTRIBUTION	REFRACTOR	STD ITEM	SAP ITEM ID	PS ITEM ID
100 W	Regulated	Type III	Prismatic Acrylic	SK20C	9317388	5821456
150 W	Regulated	Type III	Prismatic Acrylic	SK20D	9317387	5821458
250 W	Regulated	Type III	Prismatic Glass	SK20G	9317386	5821459
400 W	Regulated	Type III	Prismatic Glass	SK20H	9309716	5821460

HORIZONTAL ROADWAY LUMINAIRE

Replacement semi-cutoff refractors

FOR USE ON:	MATERIAL	STD ITEM	SAP ITEM ID	PS ITEM ID
GE Lighting Systems – 50 W – 175 Cooper Lighting – 50 W – 175 W American Electric – 50 W – 175 W	Prismatic Polycarbonate	SK50A1	9309719	5822031
GE Lighting Systems – 250 W with small housing Cooper Lighting 250 W – 400 W American Electric 250 W with small housing.	Prismatic Glass	SK50A2	9312417	2501851
GE Lighting Systems – older 250 W & 400 W with large housing.	Prismatic Glass	SK50B1	9321181	5822063
GE Lighting Systems – new 400 W American Electric – 400 W	Prismatic Glass	SK50B2	9311685	2501861

HORIZONTAL ROADWAY LUMINAIRE

Refractor attachment for use as security light

FOR USE ON:	MATERIAL	STD ITEM	SAP ITEM ID	PS ITEM ID
American Electric – LED Roadway STD ID SK06A1 and SK06A Only	Polycarbonate	SK51	9391626	N/A

HORIZONTAL ROADWAY LUMINAIRE

Replacement cutoff flat glass lens

FOR USE ON:	MATERIAL	STD ITEM	SAP ITEM ID	PS ITEM ID
GE Lighting Systems – 50 W – 250 W Cooper Lighting – 50 W – 400 W American Electric – 50 W – 250 W	Flat Tempered Glass	SK60A3	9321183	5822033
GE Lighting Systems – 400 W with older style housing	Flat Tempered Glass	SK60B3	9301993	5106589
GE Lighting Systems – 400 W with new style housing American Electric – 400 W	Flat Tempered Glass	SK60B4	9305268	5106594

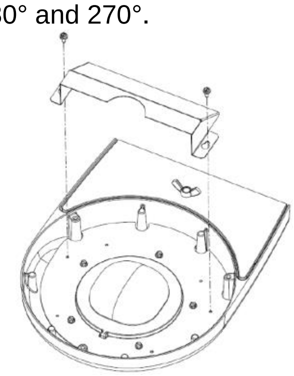
HORIZONTAL ROADWAY LUMINAIRE

360 degree external light trespass shield, aluminum

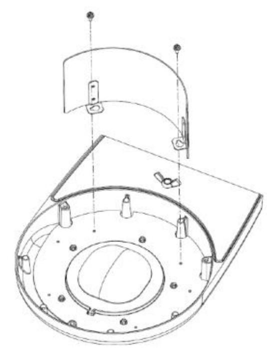
FOR USE ON:	STD ITEM	SAP ITEM ID	PS ITEM ID
GE Lighting Systems – 50 W – 250 W	SK70	9305285	5106596

HORIZONTAL ROADWAY LUMINAIRES

House side shield and light trespass shield attachments for American Electric Lighting (AEL) LED roadway luminaires STD Items SK06A1, SK06A, and SK06C. Light trespass shield can be installed in 4 positions; 0°, 90°, 180° and 270°.



House Side Shield

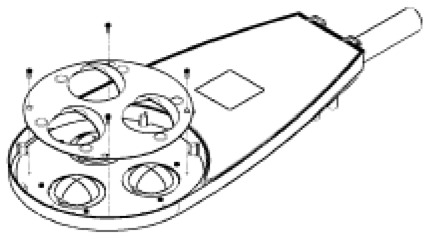


Light Trespass Shield

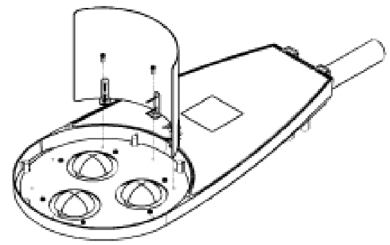
FOR USE ON:	STD ITEM	SAP ITEM ID	PS ITEM ID
AEL House Side Shield	SK70A	9391616	N/A
AEL Light Trespass Shield	SK70B	9391615	N/A

HORIZONTAL ROADWAY LUMINAIRES

House side shield and light trespass shield attachments for American Electric Lighting (AEL) LED roadway luminaires STD Item SK06G. Light trespass shield can be installed in 4 positions; 0°, 90°, 180° and 270°.



House Side Shield

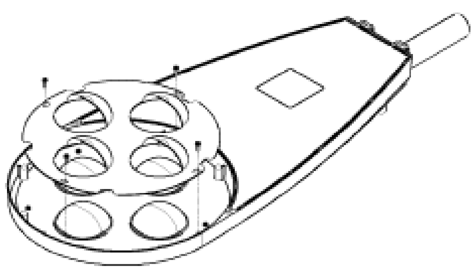


Light Trespass Shield

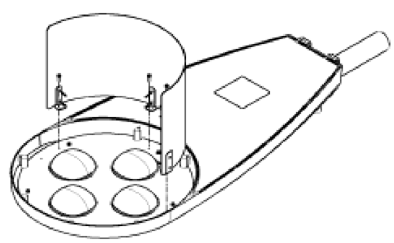
FOR USE ON:	STD ITEM	SAP ITEM ID	PS ITEM ID
AEL House Side Shield	SK70C	9393266	N/A
AEL Light Trespass Shield	SK70D	9393256	N/A

HORIZONTAL ROADWAY LUMINAIRES

House side shield and light trespass shield attachments for American Electric Lighting (AEL) LED roadway luminaires STD Item SK06H Light trespass shield can be installed in 4 positions; 0°, 90°, 180° and 270°.



House Side Shield



Light Trespass Shield

FOR USE ON:	STD ITEM	SAP ITEM ID	PS ITEM ID
AEL House Side Shield	SK70E	9393265	N/A
AEL Light Trespass Shield	SK70F	9393267	N/A

HORIZONTAL ROADWAY LUMINAIRES

Replacement Bird Guard – Black Plastic

FOR USE ON:	STD ITEM	SAP ITEM ID	PS ITEM ID
GE Lighting Systems – 50 W – 400 W	SK71	9311074	9201338

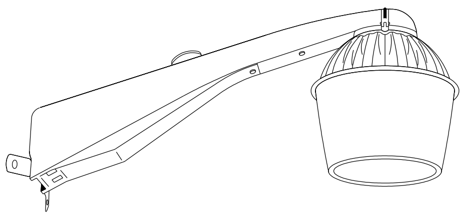
HORIZONTAL ROADWAY LUMINAIRE

Replacement Capacitors – for use *ONLY* on GE Lighting Systems HPS horizontal roadway luminaires.

FOR USE ON:	STD ITEM	SAP ITEM ID	PS ITEM ID
GE Lighting Systems – 250 W Roadway Luminaires 28uf 330VAC, 50/60hZ	SK80A	9311090	9201339
GE Lighting Systems – 400 W Roadway Luminaires 48uf 280VAC, 50/60hZ – 2” round	SK80B	9387158	none

LUMINAIRE – RESIDENTIAL SECURITY – POWERBRACKET

HID, 120 VAC, reactor ballast, IES Medium, Semi-Cutoff, Type V. Includes ring latch aluminum reflector / acrylic open bottom refractor optical assembly, GREY housing, PECR . In accordance with PPL Material Specification Standard MS-6230.



Approximate Weight = 24 pounds.

	STD ITEM	SAP ITEM ID	PS ITEM ID
100 W HPS	SN03C	9305900	5107031

OPTICAL ASSEMBLY

Ring latch, aluminum reflector / acrylic open bottom refractor optical assembly, IES semi-cutoff type V.

STD ITEM	SAP ITEM ID	PS ITEM ID
SN10	9321185	5821706

<u>*"WESTMINSTER"* TEARDROP LUMINAIRE</u>
<u>LIGHT EMITTING DIODE – (LED)</u>

LED, 120 – 277 VAC, 3,000 K LED color temperature, semi cutoff, IES Type III, prismatic glass, prepared for external NEMA 7 pin PEC. In accordance with PPL Material Specification Standard MS-6264.

Approximate Weight = 60 pounds.

HOUSING COLOR	IES DISTRIBUTION	SYSTEM WATTAGE (Maximum)	DELIVERED LUMEN OUTPUT (Minimum)	STD ITEM	SAP ITEM ID
BLACK	III	84 w LED	8,001 – 14,000	SP30CB	9393103 Y
GREEN	III	84 w LED	8,001 – 14,000	SP30CG	9393104 Y
BLACK	III	141 w LED	14,001 – 20,000	SP30DB	9393105 Y
GREEN	III	141 w LED	14,001 – 20,000	SP30DG	9393106 Y
BLACK	III	243 w LED	20,001 – 30,000	SP30GB	9393107 Y
GREEN	III	243 w LED	20,001 – 30,000	SP30GG	9393108 Y

LUMINAIRE REPLACEMENT PART –
NEMA WATTAGE LABEL

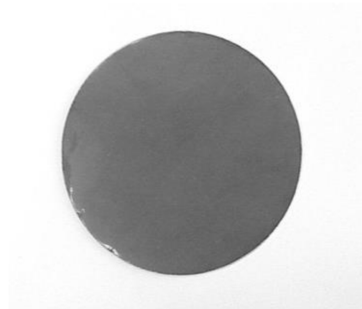
New luminaires have labels factory applied.
Replacement labels are available for maintenance.
Use 1” x 1” size labels for all post top luminaires.
Use 3” x 3” on all other luminaires. In accordance with PPL Material Specification Standard MS-6110.

LAMP WATTAGE	LEGEND	BACKGROUND COLOR	LABEL SIZE	STD ITEM	SAP ITEM ID	PS ITEM ID
50w HPS	“5”	Yellow	1” x 1”	SR03A1	9314602	0811044
70w HPS	“7”	Yellow	1” x 1”	SR03B1	9314623	0811045
100w HPS	“10”	Yellow	1” x 1”	SR03C1	9314624	0811046
150w HPS	“15”	Yellow	1” x 1”	SR03D1	9314625	0811047
50w HPS	“5”	Yellow	3” x 3”	SR03A	9314684	0811048
70w HPS	“7”	Yellow	3” x 3”	SR03B	9314683	0811049
100w HPS	“10”	Yellow	3” x 3”	SR03C	9314682	0811050
150w HPS	“15”	Yellow	3” x 3”	SR03D	9314681	0811051
250w HPS	“25”	Yellow	3” x 3”	SR03G	9314680	0811052
400w HPS	“40”	Yellow	3” x 3”	SR03H	9314679	0811053
1,000w HPS	“X1”	Yellow	3” x 3”	SR03K	9314678	0811054
175w MH	“17”	Red	1” x 1”	SR04E1	9314565	0811040
175w MH	“17”	Red	3” x 3”	SR04E	9314640	0811037
250w MH	“25”	Red	3” x 3”	SR04G	9314564	0811041
400w MH	“40”	Red	3” x 3”	SR04H	9314890	0811042
1,000w MH	“X1”	Red	3” x 3”	SR04K	9314563	0811043
175w PSMH	“17”	Red / White	1” x 1”	SR05E1	*future item*	*future item*
175w PSMH	“17”	Red / White	3” x 3”	SR05E	*future item*	*future item*
250w PSMH	“25”	Red / White	3” x 3”	SR05G	*future item*	*future item*
400w PSMH	“40”	Red / White	3” x 3”	SR05H	*future item*	*future item*

LUMINAIRE ACCESSORY –
LUMINAIRE OWNERSHIP LABEL

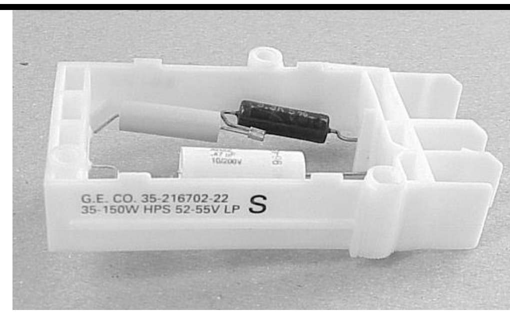
4” circular, reflective, red label. no legend.

Used to identify customer owned luminaire maintained by Massachusetts Electric Company under street lighting rate “S2”.



STD ITEM	SAP ITEM ID	PS ITEM ID
SR11	9317411[E]	5821380[E]

LUMINAIRE REPLACEMENT PART – HPS STARTER – GE LIGHTING SYSTEMS

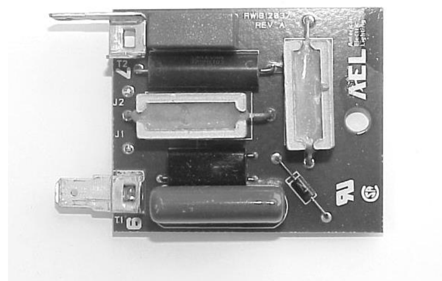


	STD ITEM	SAP ITEM ID	PS ITEM ID
Plug-in replacement for 35w – 150w luminaires	SR20A	9309827	5104839
Plug-in replacement for 250w– 400w luminaires	SR20B	9305283	5106598
Replacement for 100w luminaires - flat board type	SR20D	9312533[Y]	2503036[Y]
Replacement for 35w – 150w luminaires – flat board type	SR20E	9311673	2503013
Replacement for 250w – 400w luminaires	SR20F	9311672[Y]	2503014[Y]
Replacement for 250w – 1,000w luminaires	SR20G	9311671[Y]	2503015[Y]

LUMINAIRE REPLACEMENT PART – HPS STARTER – COOPER LIGHTING

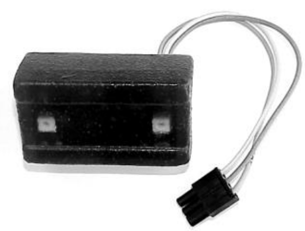
	STD ITEM	SAP ITEM ID	PS ITEM ID
Plug-in replacement for 35w – 150w luminaires – white base	SR21A	9310432	5825826
Plug-in replacement for 250w – 400w luminaires – green base	SR21B	9310428	5825827
Plug-in replacement for 150w– 400w luminaires	SR21C	9311688	2503017

LUMINAIRE REPLACEMENT PART – HPS STARTER – AMERICAN ELECTRIC



	STD ITEM	SAP ITEM ID	PS ITEM ID
Plug-in replacement for 35w – 150w luminaires – 2-wire	SR22A	9311690^{Y}	2503018^{Y}
Plug-in replacement for 35w – 150w luminaires – 3-wire	SR22B	9314599^{Y}	0810845^{Y}
Plug-in replacement for 250w – 400w luminaires	SR22C	9312534^{Y}	2503030^{Y}
Plug-in replacement for 35w – 400w luminaires – DUAL	SR22D	9309746^{E}	5825828^{E}

LUMINAIRE REPLACEMENT PART – HPS STARTER – HOLOPHANE



	STD ITEM	SAP ITEM ID	PS ITEM ID
Plug-in replacement for 50w – 150w luminaires	SR23A	9311426	2503310
Plug-in replacement for 250w – 400w luminaires	SR23B	9308016^{Y}	9202995^{Y}

WIRE & CABLE – STREET LIGHTING – LUMINAIRE SUPPLY CONDUCTORS

Use to connect all luminaires to the secondary supply. 7-strand, soft drawn copper, RHH/RHW/USE-2 600-volt insulation. In accordance with PPL Material Specification Standard MS-6150, latest issue.

DESCRIPTION	STD ITEM	SAP ITEM ID	PS ITEM ID
2-1/C #10 AWG – BLACK-WHITE twisted pair	SY4A2	9313590	9202617

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7/21 - New standard

Superceeds Issue 6/13 – Updated index to refle

Doc. # ST.25.00.001

7/21 – New standard.

7/21 - New standard

25.0 GENERAL

The distribution and sub-transmission systems are the foundation for exceeding customers' expectations in their daily energy needs and enabling a clean energy future for the more than 500 thousand customers the Company serves Rhode Island. This construction standard will support system application based upon safety, environmental, reliability, efficiency, and lifecycle costs.

25.1 IDEAL DISTRIBUTION FEEDER

This section describes the ideal distribution feeder. It is intended to represent what the Company would like to construct based upon Asset Management and Engineering principles.

The ideal distribution feeder is typically a 15kV class overhead circuit with underground sections limited to areas adjacent to the substation, urban or congested areas, locations with no overhead alternative (e.g. bridges), Underground Residential Distribution (URD), and Underground Commercial Development (UCD) systems.

1. The primary overhead construction will be either open wire on crossarms (preferred) or spacer cable and aerial cable (in heavily treed areas, or multiple circuits on the same poles, or areas where a compact configuration is necessary to maintain proper clearances).
2. The feeder mainline will be limited to three phase sections having an open tie point to an adjacent feeder. Mainline on distribution feeders shall be built with a minimum size of 477 kcmil Al.
3. On bifurcated feeders (with the bifurcation near the substation) a line recloser will be on each leg of the bifurcation.
4. All radial taps will be fused, if proper coordination cannot be maintained with a standard size fuse the use of either a three phase or multiple single phase reclosers should be considered. If it is not possible to install an automatic sectionalizing device at the radial tap location, an automatic sectionalizing device will be installed at the closest allowable location on the radial tap.
5. All normally open tie points between feeders will have either a line recloser or gang-operated loadbreak switch.
6. All three phase switching points should have either a line recloser or gang-operated loadbreak switch except riser type configurtations.
7. All secondary and services will be triplex cable (or quadraplex).
8. All new overhead primary will have a minimum size of 1/0 Al.
9. UG getaway cables exiting from the substation shall be built with a minimum size of 500 to 1000 kcmil aluminum or copper conductor.

25.2 SYSTEM RELIABILITY

Reliability of the distribution and sub-transmission system is defined as the ability to perform its function under normal and abnormal conditions. One view of distribution system performance can be determined through the use of reliability indices. To adequately measure performance, both duration and frequency of customer interruptions must be examined at various system levels. The most commonly used indices are System Average Interruption Frequency Index (SAIFI), System Average Interruption Duration Index (SAIDI), and Customer Average Interruption Duration Index (CAIDI), which all provide information about average system performance.

25.2.10 Interruption Indices

The IEEE Guide for Electric Power Distribution Reliability Indices (IEEE Std 1366) is a set of terms and definitions which can be used to foster uniformity in the development of distribution service reliability indices, to identify factors which affect the indices, and to aid in consistent reporting practices among utilities. The following are the three main indices used by the Company:

The System Average Interruption Frequency Index (SAIFI) indicates how often the average customer experiences a sustained interruption over a predefined period of time.

The System Average Interruption Duration Index (SAIDI) indicates the total duration of interruption for the average customer during a predefined period of time. It is commonly measured in minutes or hours of interruption.

The Customer Average Interruption Duration Index (CAIDI) represents the average time required to restore service.

25.2.20 Material Failure Rate Criteria

Electric material reliability data is one of the most important aspects of distribution and subtransmission system reliability assessment. Without good data, the answers provided by complicated analysis and sophisticated computer programs are meaningless.

Failure rates of overhead distribution equipment are, in general, very system specific due to their dependence on geography, weather, animals, and other factors. The industry accepted failure rates for overhead distribution equipment are shown in Table 1.

Table 1

Description	Failure Rate (failure per year)		
	Low	Typical	High
Overhead Lines			
Primary Trunk	0.020	0.100	0.300
Lateral Tap	0.020	0.160	0.300
Secondary & Service Drop	0.020	0.088	0.300
Pole Mounted Transformer	0.004	0.010	0.015
Disconnect Switch	0.004	0.014	0.140
Fuse Cutout	0.004	0.009	0.030
Line Recloser	0.005	0.015	0.030
Shunt Capacitor	0.011	0.020	0.085
Voltage Regulator	0.010	0.029	0.100

Failure rates for overhead lines are per circuit mile.
Low & high numbers are the lowest and highest values found in published literature.
Typical number is a reasonable generic value for a typical US distribution system.

7/21 – New standard.

Although most distribution circuit-miles in PPL's system are overhead, underground distribution systems are becoming more common. This increase can be largely attributed to two factors: aesthetics and reliability. Underground equipment is sheltered from vegetation and weather and usually has lower failure rates than associated overhead equipment. The industry accepted failure rates for underground distribution equipment are shown in Table 2.

Table 2

Description		Failure Rate (failure per year)		
		Low	Typical	High
Underground Cable				
	Primary Cable	0.020	0.100	0.300
	Secondary Cable	0.020	0.160	0.300
Elbow Connectors		0.004	0.010	0.015
Cable Splices & Joints		0.004	0.014	0.140
Padmount Transformers		0.004	0.009	0.030
Padmount Switches		0.005	0.015	0.030

Failure rates for overhead lines are per circuit mile.
Low & high numbers are the lowest and highest values found in published literature.
Typical number is a reasonable generic value for a typical US distribution system.

Once a failure rate for a typical material item is calculated, it can then be compared to such industry accepted failure rates to help determine future risk and exposure.

7/21 - New standard

25.3 SELF-HEALING ELECTRIC SYSTEMS

Commented [KJH1]: How does "25.3 SELF-HEALING ELECTRIC SYSTEMS" differentiate from "25.4 FAULT LOCATION, ISOLATION, AND SERVICE RESTORATION (FLISR)? (FLISR seems to be one, main, component of a "self-healing" grid... subsection perhaps?)

Self-healing electric systems use Intelligent Electronic Devices (IED) such as: reclosers, switchgear, and sophisticated protective equipment; advanced capacitor banks, voltage regulating equipment (e.g., power electronics / inverters, line regulators, etc.); and power quality sensors. Together, these IEDs allow for a more reliable grid that is less dependent on traditional, distribution equipment. Telemetry from such assets provides increased insight and visibility of distribution and subtransmission system performance. Subsequently, the self-healing grid requires a robust communications infrastructure to monitor, report, control, and optimize the reconfiguration process of the distribution network.

25.4 FAULT LOCATION, ISOLATION, AND SERVICE RESTORATION (FLISR)

Fault Location, Isolation, and Service Restoration (FLISR) is the most recent technology advancement made for fast outage restoration. When a fault is detected, the upstream switch opens, which immediately initiates the FLISR technology. Using programmed logic, FLISR quickly implements a switching scheme to isolate the outage to as few customers as possible.

Commented [IS2]: Change to "trip signal is sent to the server hoating"

25.4.10 Restoration Logic

Restoration logic uses sophisticated processing to ensure that several pre-set constraints are respected. The following factors and priorities should be considered in determining an optimal load restoration strategy:

1. Recommendations do not cause new overloads or violations beyond a user-specified tolerance when implemented.
2. Recommendations will minimize switching actions.
3. The priority is to restore entire de-energized islands. If it is unable to do that, FLISR attempts to restore the maximum load possible by splitting de-energized islands.
4. When transferring loads, feeders belonging to the same substation are prioritized. If this is not possible, transfers to feeders from other substations are considered.

5. The priority is to transfer loads to immediately adjacent feeders (i.e.: first neighbor). If this is not possible without overloading adjacent feeders, transfers to second neighbors are possible.
6. An available configuration option is to consider the estimated network loading for the next 24 hours when validating switching recommendations. This option guarantees that the recommendations are valid for that specified time frame.
7. Recommendations include consideration for Distributed Energy Resources (DERs) that may affect loading levels, post-restoration, in accordance with associated interconnection agreements, etc.

25.5 VOLT-VAR CONTROL AND OPTIMIZATION

Commented [KJH3]: Possibly consider "VOLT-VAR OPTIMIZATION AND CONSERVATION VOLTAGE REDUCTION"

It may then be good to break into two categories where we first discuss optimizing VAR flow on the grid for enhanced system efficiency, capacity relief, etc. and then a second session describing how voltage profiles are flattened through the optimization process and can then be lowered for reduced energy consumption, etc..

Implementing Volt/Var Optimization (VVO) throughout the distribution system is paramount to optimizing the grid. To do this, remote monitoring via sensors must provide the distribution management system with real-time data from many points along the distribution line down to the grid's edge. These advanced sensors throughout the distribution system allow utilities to control VAR demand and voltage regulation for intelligent decision-making. The smart sensors record and provide real-time and accurate data about distribution feeder line and equipment conditions. This data provides utilities with a comprehensive understanding of feeder load and voltage conditions from the substation to the end of the line. When used in conjunction with advanced capacitor banks and voltage regulating devices, VVO can minimize losses by optimizing VAR levels to control the system voltage. A simple VVO scheme is represented in Figure 1.

7/21 – New standard.

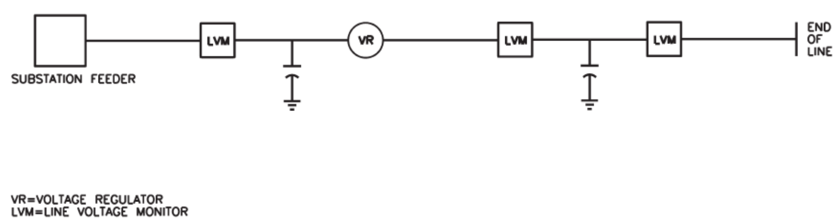


Figure 1 – Simple VVO Scheme

VVO benefits are significant. They provide enhanced reliability, efficiency and more. By optimizing the grid conditions, utilities can minimize system losses and demand through a lower voltage profile and in turn reduce end users' energy consumption, lowering their costs and environmental impacts. This form of distribution automation allows electric utilities to control demand and increase distribution system efficiency. Peak demand can also be alleviated by using VVO, which would optimize asset utilization, extend the life of the infrastructure and, thus, reduce the need for additional investment in new infrastructure.

7/21 - New standard

25.6 ADVANCED METER INFRASTRUCTURE (AMI)

Advanced Metering Infrastructure (AMI) provides monitoring and granular data to support customer decisions, grid operations, and control capabilities that will enable the desired functions of a modern distribution system.

Granular, time-series data from smart meters and other intelligent devices at customers' premises enable advanced analyses, innovative rate designs, and customer engagement strategies which benefit both the customers and the grid. Voltage sensing and measurement functions support increased system efficiency and enable improved outage detection and restoration processes.

Pole-mounted meter aggregation nodes allow for the utilization of AMI by grid system operators.

25.7 COMMUNICATION SYSTEMS

Communication infrastructure is critical for the successful operation of the distribution and subtransmission systems. The use of communication technologies ensures the reduction of energy consumption and optimal operation of all intelligent electronic devices.

25.8.10 Distributed Network Protocol (DNP3)

The Distributed Network Protocol (DNP3) is the standard protocol for distribution and subtransmission devices. The protocol is suitable for operation on a variety of communication media consistent with the makeup of most electric power communication systems. The IEEE Standard for Electric Power Systems Communications—Distributed Network Protocol (DNP3) (IEEE Std 1815) specifies the DNP3 protocol structure, functions, and application alternatives.

25.8.20 Cellular Communication Solutions

The Company has standardized on the wireless GE MDS Orbit cellular router. The wireless router enables the Company to extend secure and reliable cellular connectivity using public networks to distribution and sub-transmission devices for monitoring and control. A low-gain omnidirectional pole mounted radio antenna is required to transmit signals.

If cellular coverage is limited, a high-gain directional pole mounted radio antenna is required to increase signal strength.

The pole mounted radio antenna construction drawings are shown on drawing 25-300.

Commented [KJH4]: What "other intelligent devices"? We probably need to be careful here as we, as a utility, often do not have visibility into Home Area Networks (HAN) or Home Energy Management Systems. Not sure what was intended here though...

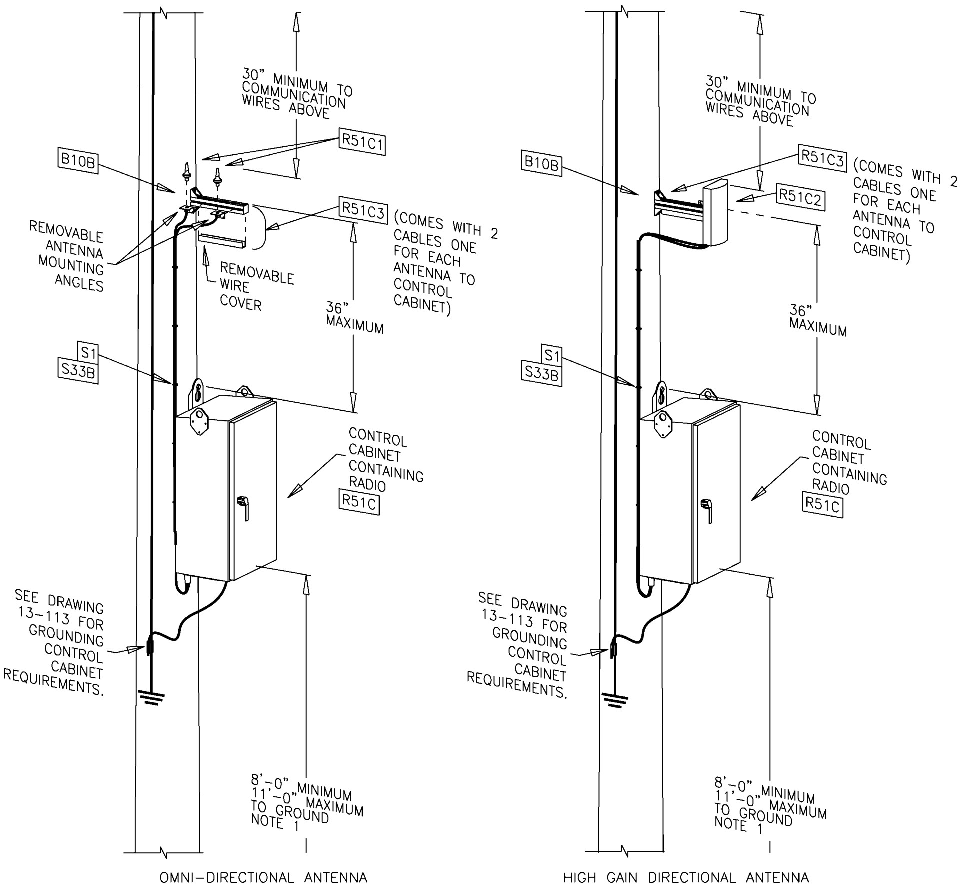
Commented [KJH5]: May be good to relate to VVO / CVR effors and how AMI systems can help support / augment this capability, and may even result in fewer power sensors required to achieve such functionality.

Commented [KJH6]: We should shy away from terms such as "Connected Grid Routers (CGRs)" as that is specific to Cisco and Itron's proposed AMI solution. A vendor has not yet been selected / awarded NG's AMI contract and so I would be looking to keep this as generic as possible.

Commented [KJH7]: I would delete this sentence as I don't know that it's all that factual. To-date we have only passed meter traffic via a CGR from an unlicensed, 900MHz. mesh network to a cellular backhaul. No grid equipment has been integrated to CGRs on our production systems.

Commented [IS8]: Change Ensures to Enables

Commented [IS9]: Possibly switch the order of 25.8.10 and 25.8.20 - My thought is that Cellular Communication is the conduit and DNP3 is the information.
So, first describe Cellular Communication, then say that DNP3 packets are the data/intelligence that's transmitted through the cellular network.



NOTE
1.ON NEW INSTALL 3' MAXIMUM ABOVE ENCLOSURE, FOR RETROFIT ANY DISTANCE ABOVE ENCLOSURE. OPERATION CAN INSTALL FROM LADDER.
2. OMNI-DIRECTIONAL ANTENNA IS THE STANDARD INSTALLATION TO BE USED ON ANY OVERHEAD STANDARD ARRANGEMENT WITH EQUIPMENT THAT REQUIRES SUCH. HIGH GAIN DIRECTIONAL ANTENNA TO BE USED WHEN IT IS DETERMINED BY ENGINEERING AND OPERATIONS.

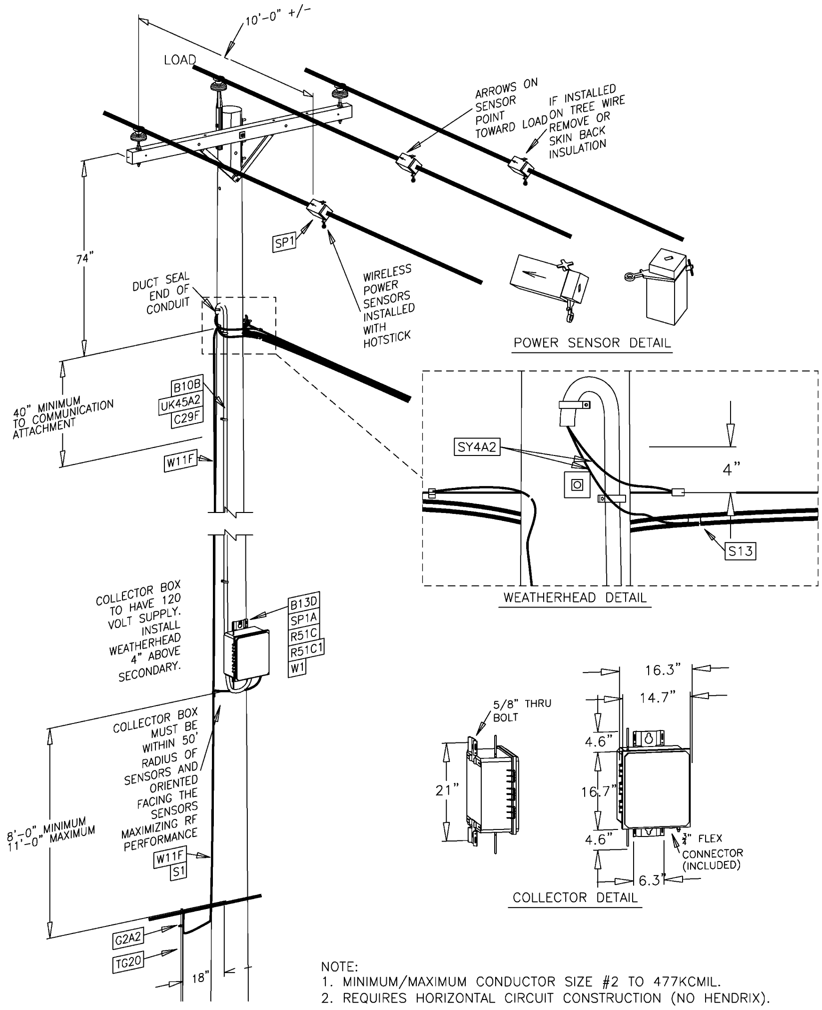
Designer	Drawing	Date
MPR	od25100	7/15/19

7/21 – New standard.

COMPANY OWNED POLE MOUNTED RADIO ANTENNA INSTALLATION

ISSUE	PAGE NUMBER		
7/21	25-300	OVERHEAD CONSTRUCTION STANDARD	ppl

7/21 – New Standard



NOTE:
1. MINIMUM/MAXIMUM CONDUCTOR SIZE #2 TO 477KCMIL.
2. REQUIRES HORIZONTAL CIRCUIT CONSTRUCTION (NO HENDRIX).

Designer	Drawing	Date
MPR	od25650	7/15/19

TYPICAL INSTALLATION OF POWER LINE SENSOR WITH COLLECTOR BOX			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER 25-650	ISSUE 7/21

Version	Date	Modification	Author(s)	Approval by (Name/Title)
1	7/21	• Created new standard		

7/21 – New standard.

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7/21 - New standard

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Electric material reliability data is one of the most important aspects of distribution and subtransmission system reliability assessment. Without good data, the answers provided by complicated analysis and sophisticated computer programs are meaningless.

Failure rates of overhead distribution equipment are, in general, very system specific due to their dependence on geography, weather, animals, and other factors. The industry accepted failure rates for overhead distribution equipment are shown in Table 1.

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Description	Failure Rate (failure per year)		
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Line Recloser	0.005	0.015	0.030
Shunt Capacitor	0.011	0.020	0.085
Voltage Regulator	0.010	0.029	0.100

Failure rates for overhead lines are per circuit mile.
Low & high numbers are the lowest and highest values found in published literature.
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7/21 – New standard.

Although most distribution circuit-miles in PPL's system are overhead, underground distribution systems are becoming more common. This increase can be largely attributed to two factors: aesthetics and reliability. Underground equipment is sheltered from vegetation and weather and usually has lower failure rates than associated overhead equipment. The industry accepted failure rates for underground distribution equipment are shown in Table 2.

Table 2

Description	Failure Rate (failure per year)		
	Low	Typical	High
Underground Cable			
Primary Cable	0.020	0.100	0.300
Secondary Cable	0.020	0.160	0.300
Elbow Connectors	0.004	0.010	0.015
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7/21 - New standard

25.3 SELF-HEALING ELECTRIC SYSTEMS

Self-healing electric systems use Intelligent Electronic Devices (IED) such as: reclosers, switchgear, and sophisticated protective equipment; advanced capacitor banks, voltage regulating equipment (e.g., power electronics / inverters, line regulators, etc.); and power quality sensors. Together, these IEDs allow for a more reliable grid that is less dependent on traditional, distribution equipment. Telemetry from such assets provides increased insight and visibility of distribution and subtransmission system performance. Subsequently, the self-healing grid requires a robust communications infrastructure to monitor, report, control, and optimize the reconfiguration process of the distribution network.

25.4 FAULT LOCATION, ISOLATION, AND SERVICE RESTORATION (FLISR)

Fault Location, Isolation, and Service Restoration (FLISR) is the most recent technology advancement made for fast outage restoration. When a fault is detected, the upstream switch opens, which immediately initiates the FLISR technology. Using programmed logic, FLISR quickly implements a switching scheme to isolate the outage to as few customers as possible.

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Restoration logic uses sophisticated processing to ensure that several pre-set constraints are respected. The following factors and priorities should be considered in determining an optimal load restoration strategy:

1. Recommendations do not cause new overloads or violations beyond a user-specified tolerance when implemented.
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Implementing Volt/Var Optimization (VVO) throughout the distribution system is paramount to optimizing the grid. To do this, remote monitoring via sensors must provide the distribution management system with real-time data from many points along the distribution line down to the grid's edge. These advanced sensors throughout the distribution system allow utilities to control VAR demand and voltage regulation for intelligent decision-making. The smart sensors record and provide real-time and accurate data about distribution feeder line and equipment conditions. This data provides utilities with a comprehensive understanding of feeder load and voltage conditions from the substation to the end of the line. When used in conjunction with advanced capacitor banks and voltage regulating devices, VVO can minimize losses by optimizing VAR levels to control the system voltage. A simple VVO scheme is represented in Figure 1.

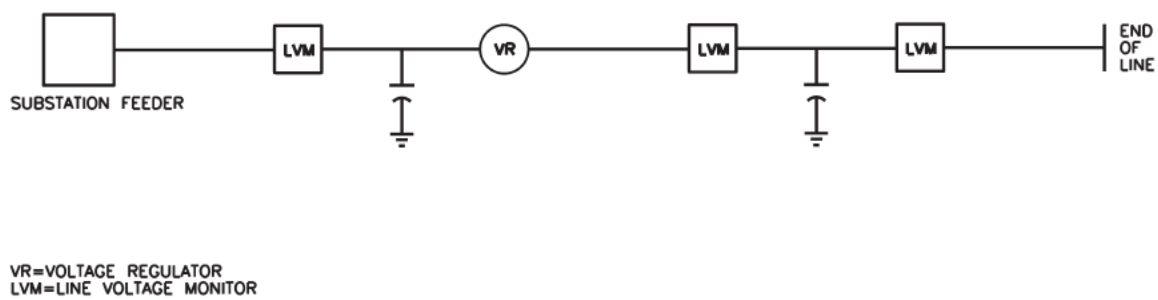

Figure 1 – Simple VVO Scheme

7/21 - New standard

VVO benefits are significant. They provide enhanced reliability, efficiency and more. By optimizing the grid conditions, utilities can minimize system losses and demand through a lower voltage profile and in turn reduce end users' energy consumption, lowering their costs and environmental impacts. This form of distribution automation allows electric utilities to control demand and increase distribution system efficiency. Peak demand can also be alleviated by using VVO, which would optimize asset utilization, extend the life of the infrastructure and, thus, reduce the need for additional investment in new infrastructure.

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Pole-mounted meter aggregation nodes allow for the utilization of AMI by grid system operators.

25.7 COMMUNICATION SYSTEMS

Communication infrastructure is critical for the successful operation of the distribution and subtransmission systems. The use of communication technologies ensures the reduction of energy consumption and optimal operation of all intelligent electronic devices.

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The Distributed Network Protocol (DNP3) is the standard protocol for distribution and subtransmission devices. The protocol is suitable for operation on a variety of communication media consistent with the makeup of most electric power communication systems. The IEEE Standard for Electric Power Systems Communications—Distributed Network Protocol (DNP3) (IEEE Std 1815) specifies the DNP3 protocol structure, functions, and application alternatives.

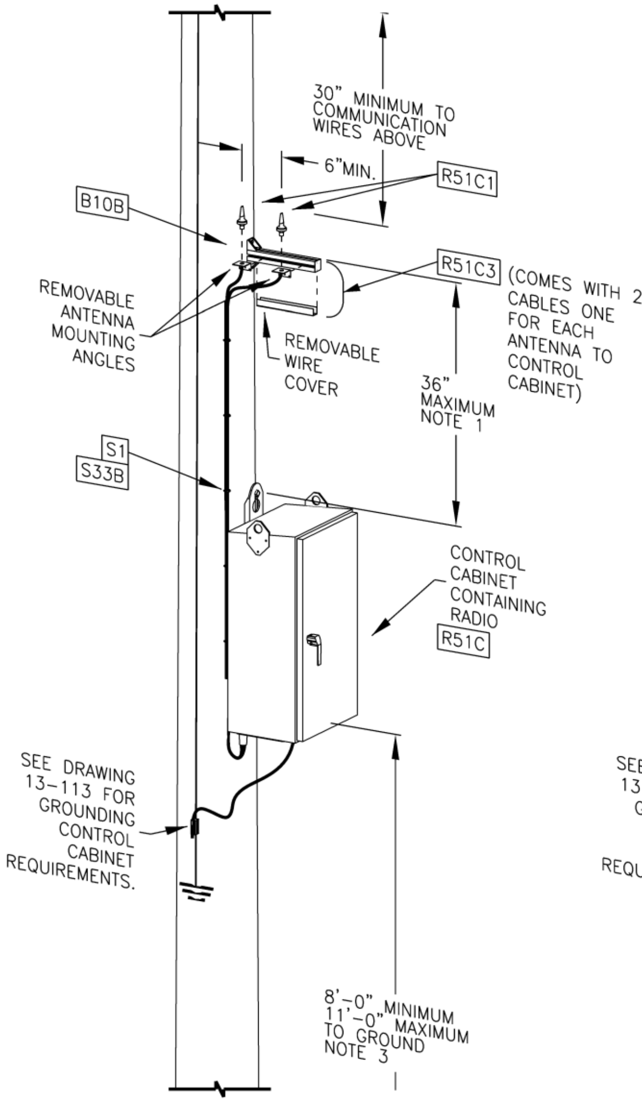
25.7.20 Cellular Communication Solutions

The Company has standardized on the wireless GE MDS Orbit cellular router. The wireless router enables the Company to extend secure and reliable cellular connectivity using public networks to distribution and sub-transmission devices for monitoring and control. A low-gain omnidirectional pole mounted radio antenna is required to transmit signals.

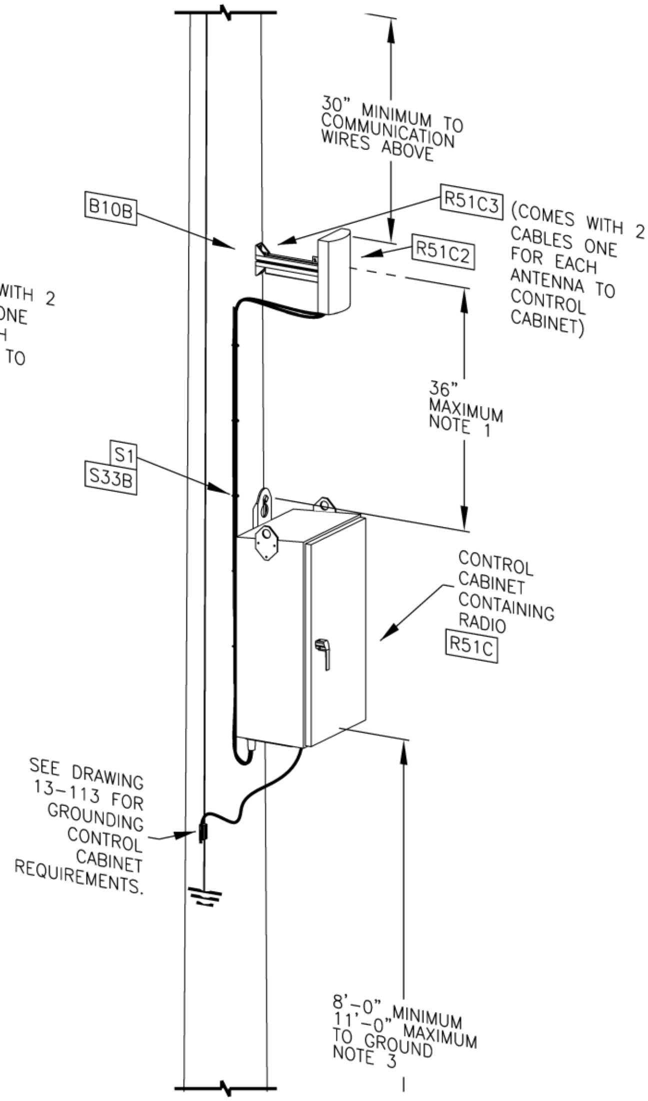
If cellular coverage is limited, a high-gain directional pole mounted radio antenna is required to increase signal strength.

The pole mounted radio antenna construction drawings are shown on drawing 25-100.

7/21 - New standard



OMNI-DIRECTIONAL ANTENNA



HIGH GAIN DIRECTIONAL ANTENNA

NOTE

1.ON NEW INSTALL 3' MAXIMUM ABOVE ENCLOSURE, FOR RETROFIT ANY DISTANCE ABOVE ENCLOSURE. OPERATION CAN INSTALL FROM LADDER.

2. OMNI-DIRECTIONAL ANTENNA IS THE STANDARD INSTALLATION TO BE USED ON ANY OVERHEAD STANDARD ARRANGEMENT WITH EQUIPMENT THAT REQUIRES SUCH. HIGH GAIN DIRECTIONAL ANTENNA TO BE USED WHEN IT IS DETERMINED BY ENGINEERING AND OPERATIONS.

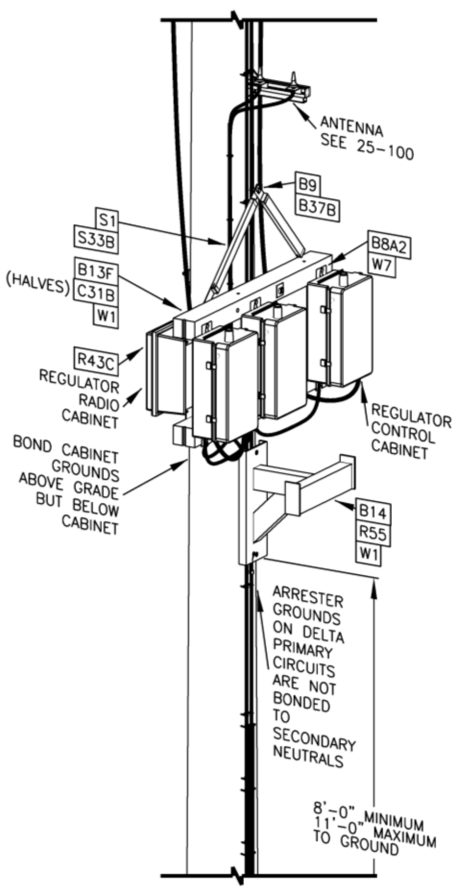
3. THE CONTROL CABINET MAY BE MOUNTED LOWER THAN 8' PROVIDED SUCH CONTROL CABINETS DO NOT OVERHANG ROADWAYS OR OBSTRUCT PEDESTRIAN TRAFFIC, AND AFTER FULL CONSIDERATION OF WORKER AND PUBLIC SAFETY, POSSIBLE VANDALISM, AND AESTHETICS. A GROUND GRID (13-114) SHALL BE INSTALLED.

Designer	Drawing	Date
MPR	od25100	6/13/20

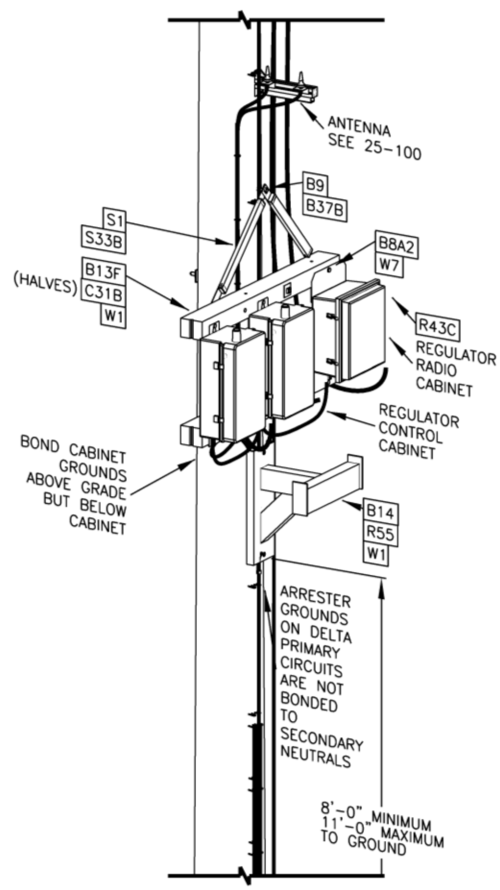
Supersedes 7/20 – Update Notes.

COMPANY OWNED POLE MOUNTED RADIO ANTENNA			
ISSUE	PAGE NUMBER	OVERHEAD CONSTRUCTION STANDARD	ppl
7/19	25-100		

7/21 - New standard



3ø (3) REGULATOR CONTROL CABINET DETAIL



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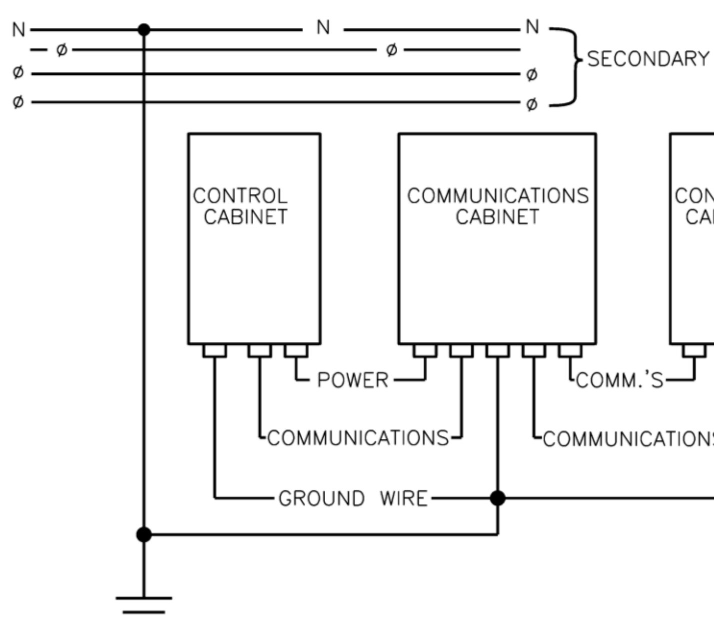

COMMUNICATION CABINET WIRING

NOTES:
1. REFER TO 25-100 FOR TELECOM REQUIREMENTS.
2. REFER TO SECTION 13 FOR GROUNDING DETAILS.

Designer	Drawing	Date
MPR	od25101	5/14/21

VOLTAGE REGULATOR COMMUNICATIONS WIRING DIAGRAM

	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
ppl		25-101	7/21

Version	Date	Modification	Author(s)	Approval by (Name/Title)
3	7/21	• Text additions/modifications • Added 25-101		
2	7/20	• Updated drawing 25-100 • Added drawing 25-100		
1	7/19	• Created new standard		

7/21 - New standard

25.0 GENERAL

The distribution and sub-transmission systems are the foundation for exceeding customers' expectations in their daily energy needs and enabling a clean energy future for the more than 500 thousand customers the Company serves in Rhode Island. This construction standard will support system application based upon safety, environmental, reliability, efficiency, and lifecycle costs.

25.1 IDEAL DISTRIBUTION FEEDER

This section describes the ideal distribution feeder. It is intended to represent what the Company would like to construct based upon Asset Management and Engineering principles.

The ideal distribution feeder is typically a 15kV class overhead circuit with underground sections limited to areas adjacent to the substation, urban or congested areas, locations with no overhead alternative (e.g. bridges), Underground Residential Distribution (URD), and Underground Commercial Development (UCD) systems.

1. The primary overhead construction will be either open wire on crossarms (preferred) or spacer cable and aerial cable (in heavily treed areas, or multiple circuits on the same poles, or areas where a compact configuration is necessary to maintain proper clearances).
2. The feeder mainline will be limited to three phase sections having an open tie point to an adjacent feeder. Mainline on distribution feeders shall be built with a minimum size of 477 kcmil Al.
3. On bifurcated feeders (with the bifurcation near the substation) a line recloser will be on each leg of the bifurcation.
4. All radial taps will be fused, if proper coordination cannot be maintained with a standard size fuse the use of either a three phase or multiple single phase reclosers should be considered. If it is not possible to install an automatic sectionalizing device at the radial tap location, an automatic sectionalizing device will be installed at the closest allowable location on the radial tap.
5. All normally open tie points between feeders will have either a line recloser or gang-operated loadbreak switch.
6. All three phase switching points should have either a line recloser or gang-operated loadbreak switch except riser type configurations.
7. All secondary and services will be triplex cable (or quadraplex).
8. All new overhead primary will have a minimum size of 1/0 Al.
9. UG getaway cables exiting from the substation shall be built with a minimum size of 500 to 1000 kcmil aluminum or copper conductor.

25.2 SYSTEM RELIABILITY

Reliability of the distribution and sub-transmission system is defined as the ability to perform its function under normal and abnormal conditions. One view of distribution system performance can be determined through the use of reliability indices. To adequately measure performance, both duration and frequency of customer interruptions must be examined at various system levels. The most commonly used indices are System Average Interruption Frequency Index (SAIFI), System Average Interruption Duration Index (SAIDI), and Customer Average Interruption Duration Index (CAIDI), which all provide information about average system performance.

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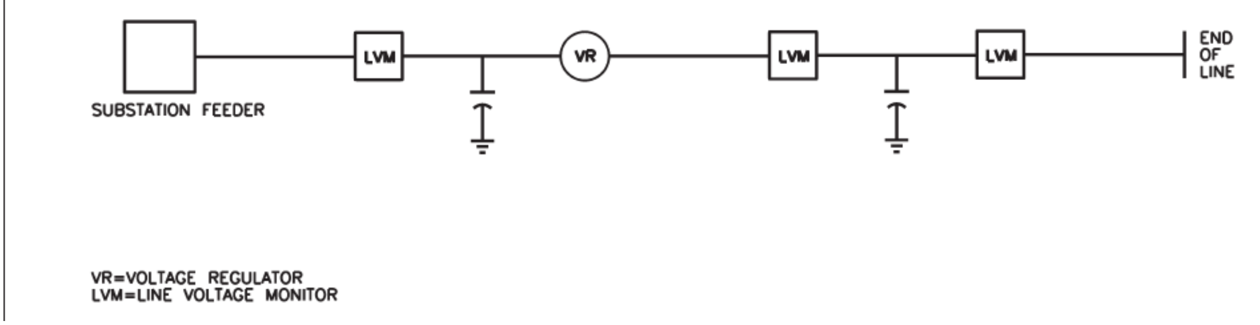

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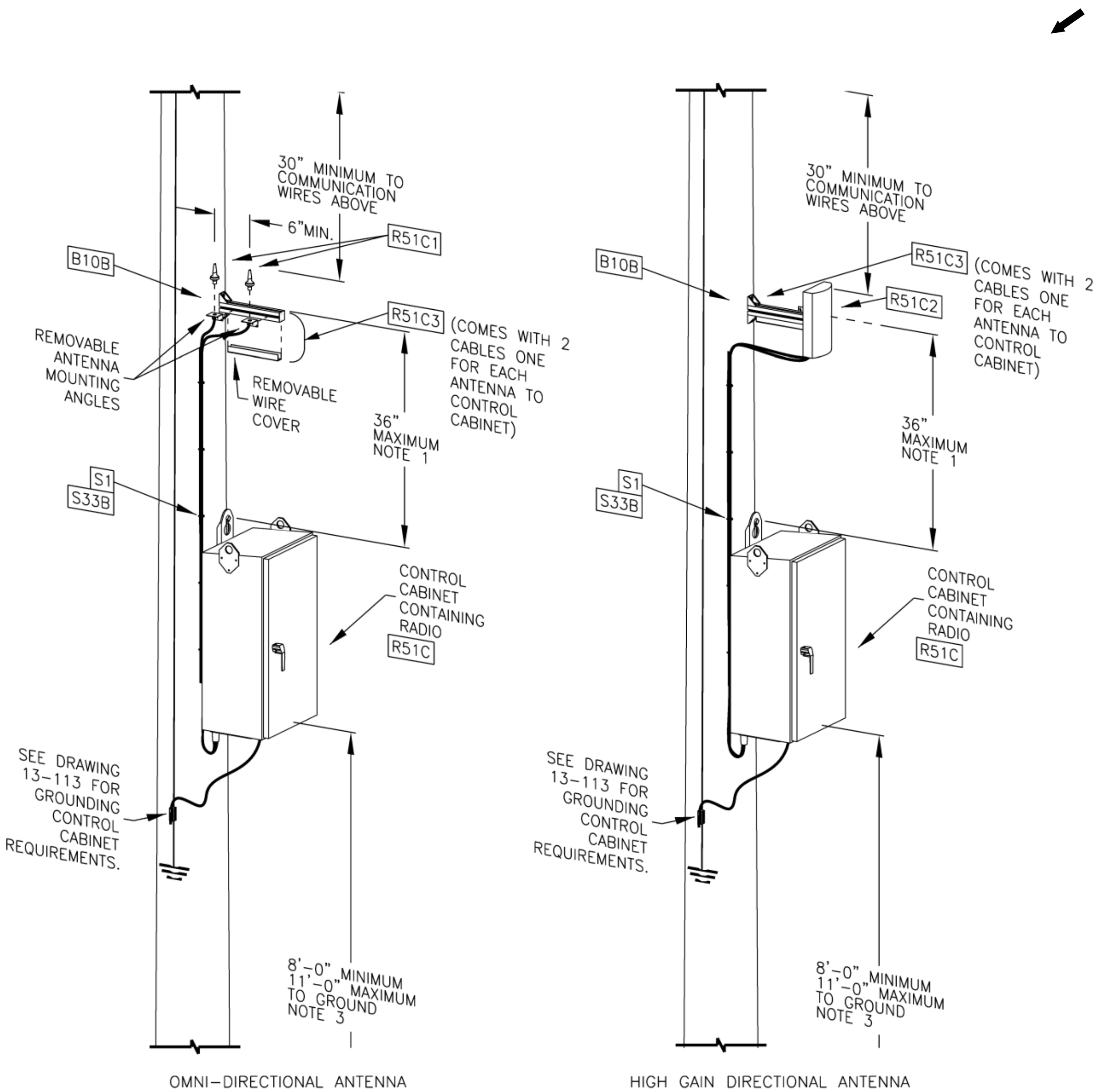
7/21 - New standard



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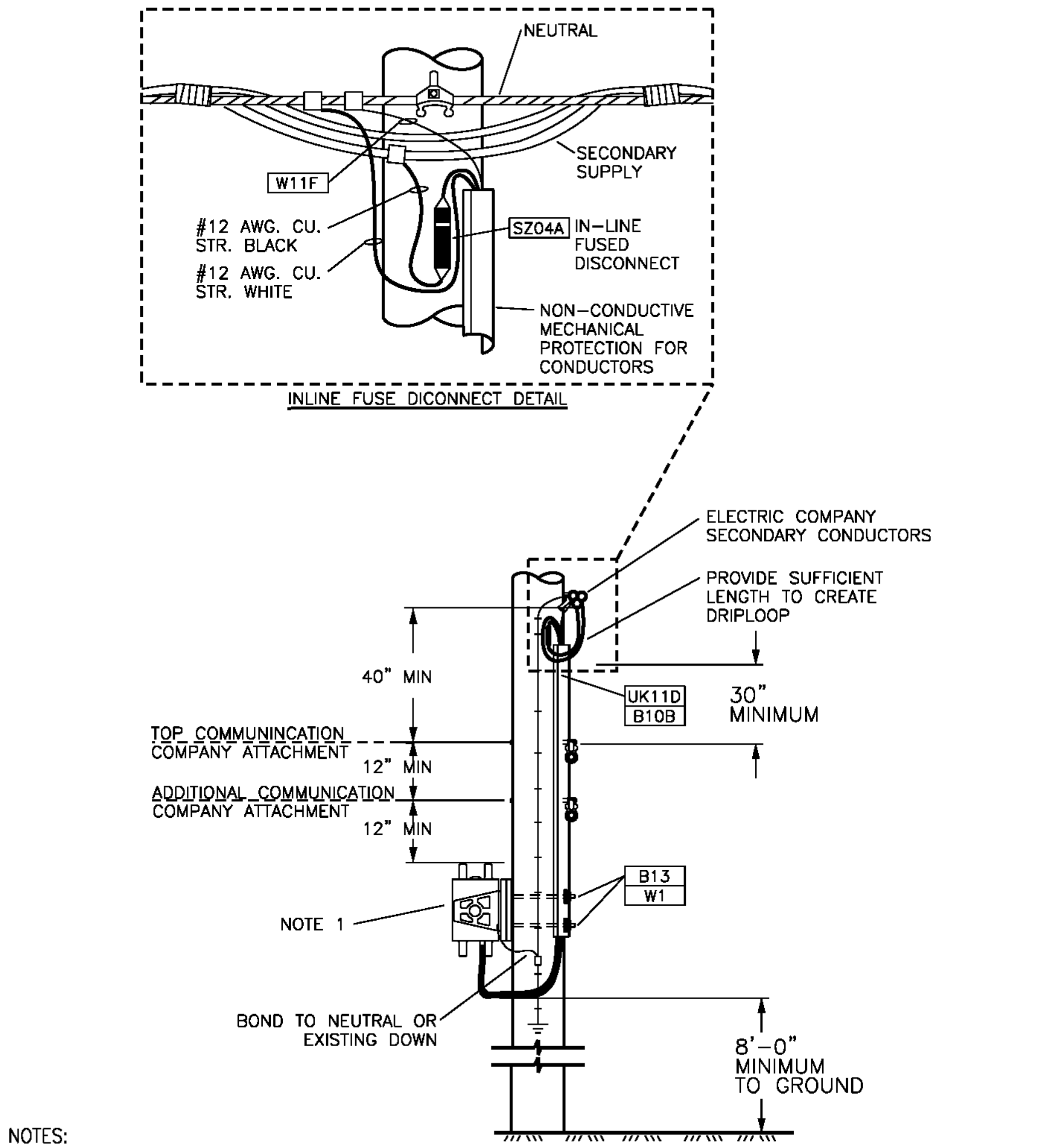
Designer	Drawing	Date
MPR	od25100	6/13/20

Supersedes 7/20 – Update Notes.

7/21 – New Standard



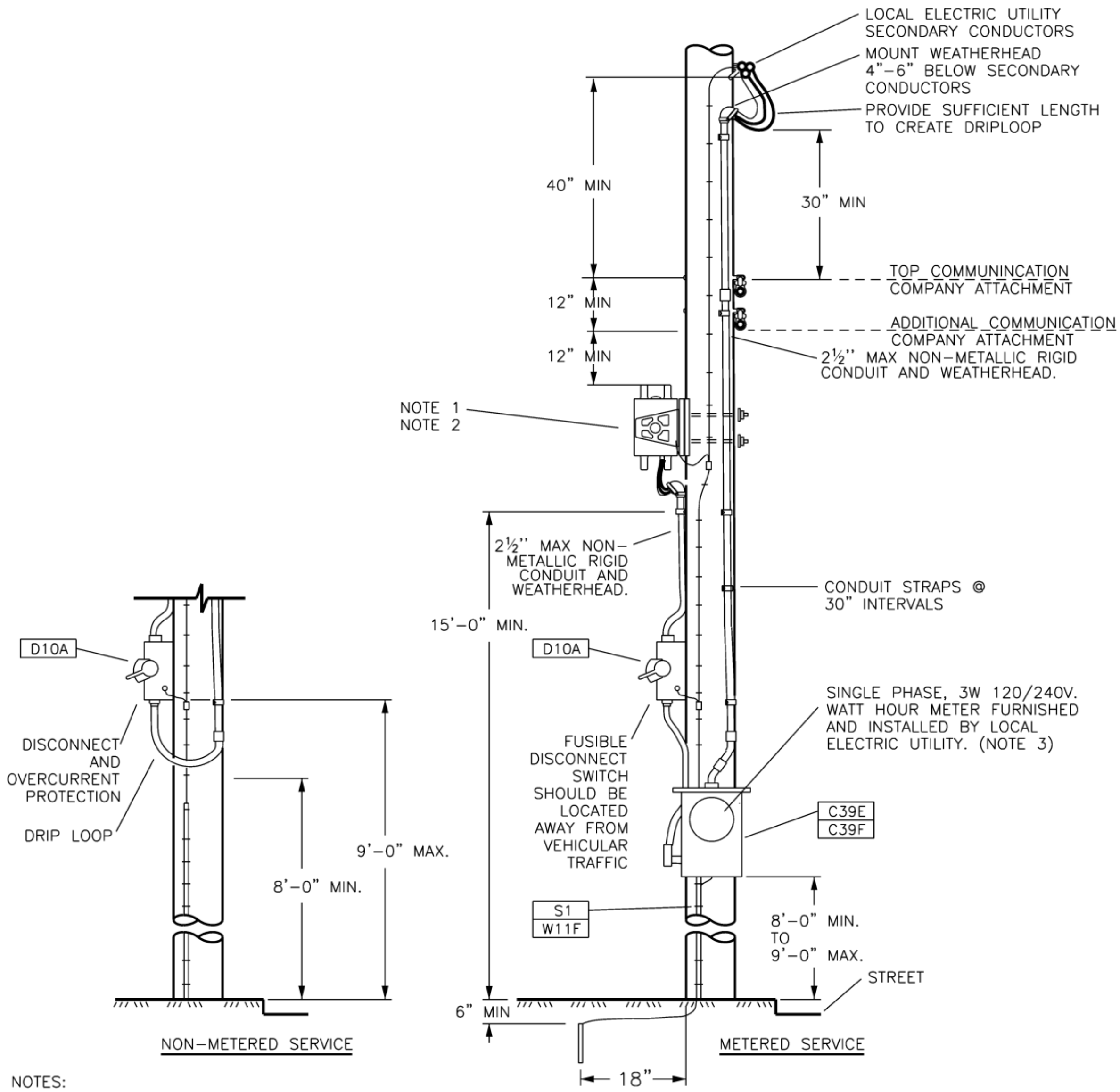
NOTES:

1. POLES SELECTED FOR COMMUNICATION MOUNTED EQUIPMENT SHALL BE RELATIVELY "CLEAN" POLES, FREE OF ANY OTHER MAJOR EQUIPMENT, AND ACCESSIBLE BY BUCKET TRUCK THROUGHOUT THE YEAR. ANTENNAS SHALL NOT BE INSTALLED ON POLES WITH AIRBREAK OR LOADBREAK SWITCHES, LINE RECLOSERS, SECTIONALIZERS, CAPACITORS, VOLTAGE REGULATORS, TRANSFORMERS, MAJOR COMMUNICATIONS OR FIRE ALARM EQUIPMENT, OTHER ANTENNAS, THREE OR FOUR-WAY PRIMARY JUNCTION POLES AND BACKYARD POLES.

Designer	Drawing	Date
MPR	od25110	6/25/21

COMPANY OWNED CONNECTED GRID ROUTER

7/21 – New standard.



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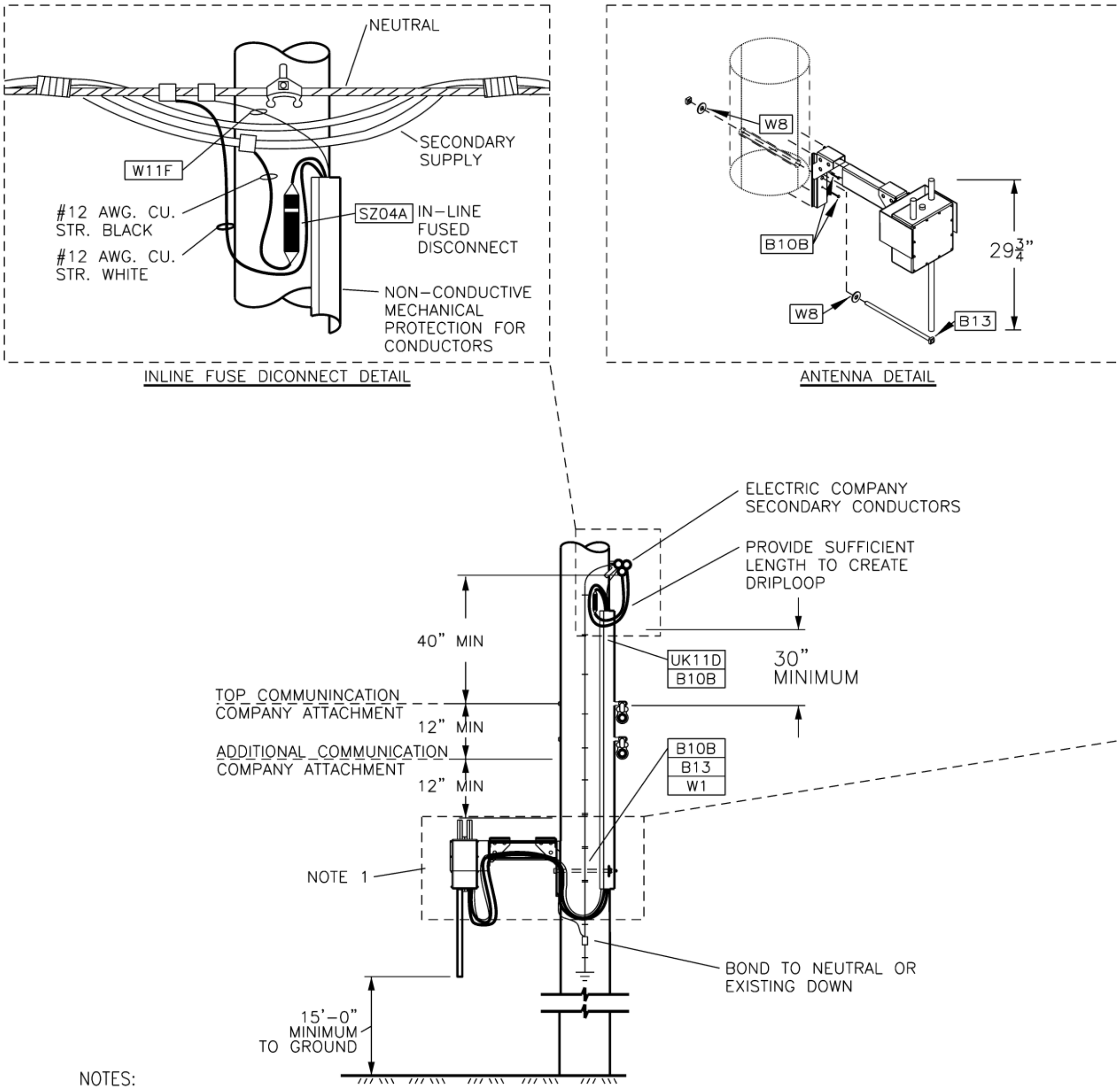
2. NATIONAL GRID SHALL FURNISH, INSTALL, OWN, AND MAINTAIN ALL MATERIAL AND EQUIPMENT SHOWN ABOVE, EXCEPT AS NOTED. REFER TO SERVICE REQUIREMENTS OF ELECTRIC SERVICE PROVIDER.
3. LOCATE METER SOCKET AWAY FROM VEHICULAR TRAFFIC FLOW AND REFER TO ESB #750 OR ESIR – FIGURES 3 AND 17 FOR DETAILS AND INSTALLATION NOTES. METER SOCKET SHALL BE INSTALLED IN TRUE VERTICAL POSITION ON APPROVED SUPPORT. SEE PG. 17–107 FOR 120V OR 110V INSTALLATION.

Designer	Drawing	Date
MPR	od25110A	7/15/21

AMI GRID CONNECTED ROUTER INSTALL ON THIRD PARTY OWNED FOREIGN UTILITY

7/21 – New Standard



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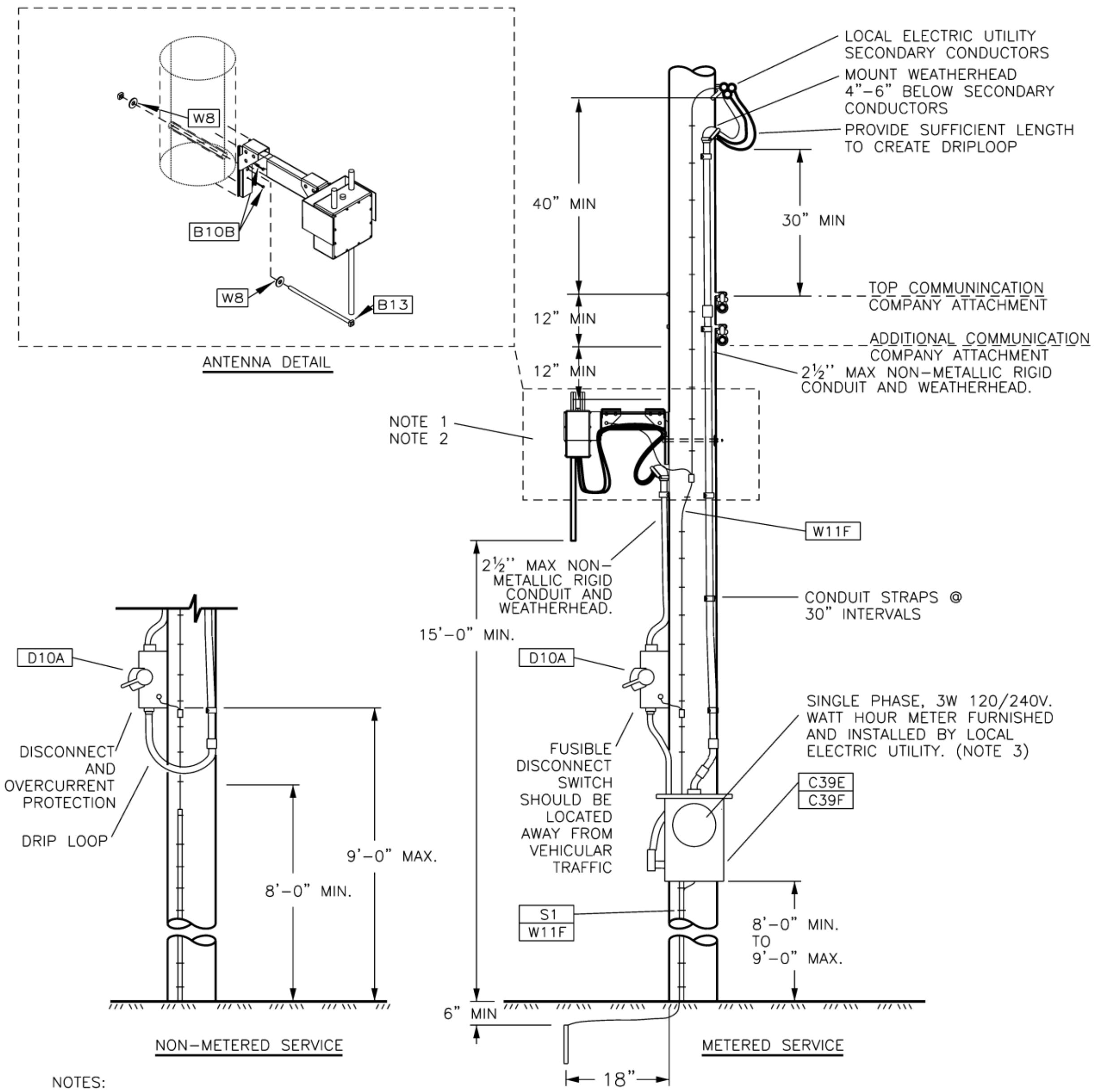
Designer	Drawing	Date
MPR	od25111	6/25/21

COMPANY INSTALLED NETWORK GATEWAY



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3. LOCATE METER SOCKET AWAY FROM VEHICULAR TRAFFIC FLOW AND REFER TO ESB #750 OR ESIR - FIGURES 3 AND 17 FOR DETAILS AND INSTALLATION NOTES. METER SOCKET SHALL BE INSTALLED IN TRUE VERTICAL POSITION ON APPROVED SUPPORT. SEE PG. 17-107 FOR 120V OR 110V INSTALLATION.

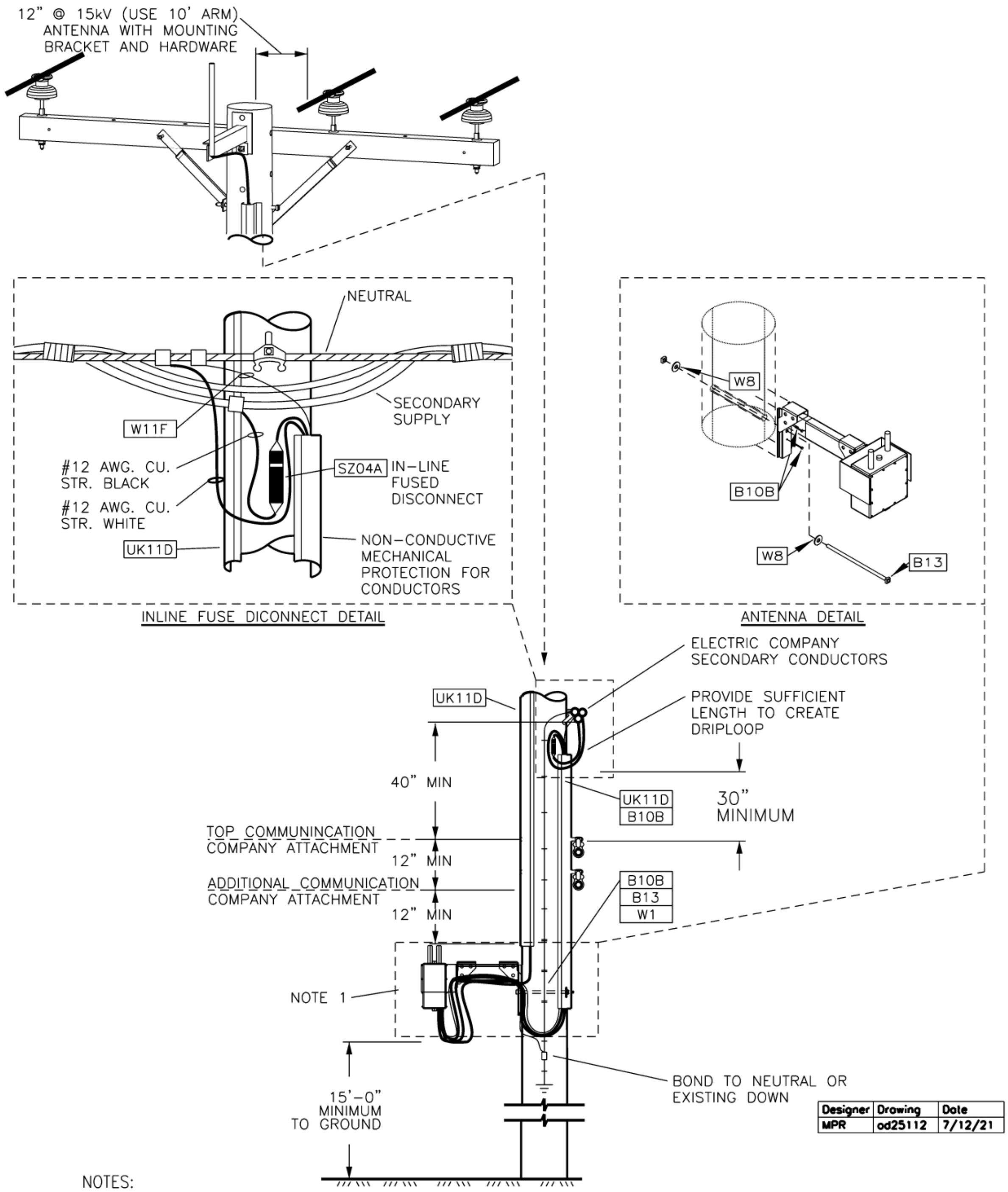
Designer	Drawing	Date
MPR	od25111A	7/15/21

AMI GATEWAY INSTALL ON THIRD PARTY OWNED FOREIGN UTILITY

7/21 – New standard.

NETWORK GATEWAY WITH SINGLE ANTENNA INSTALL ON THIRD PARTY OWNED FOREIGN UTILITY			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER: 25-111A	ISSUE: 7/21

7/21 – New Standard



NOTES:

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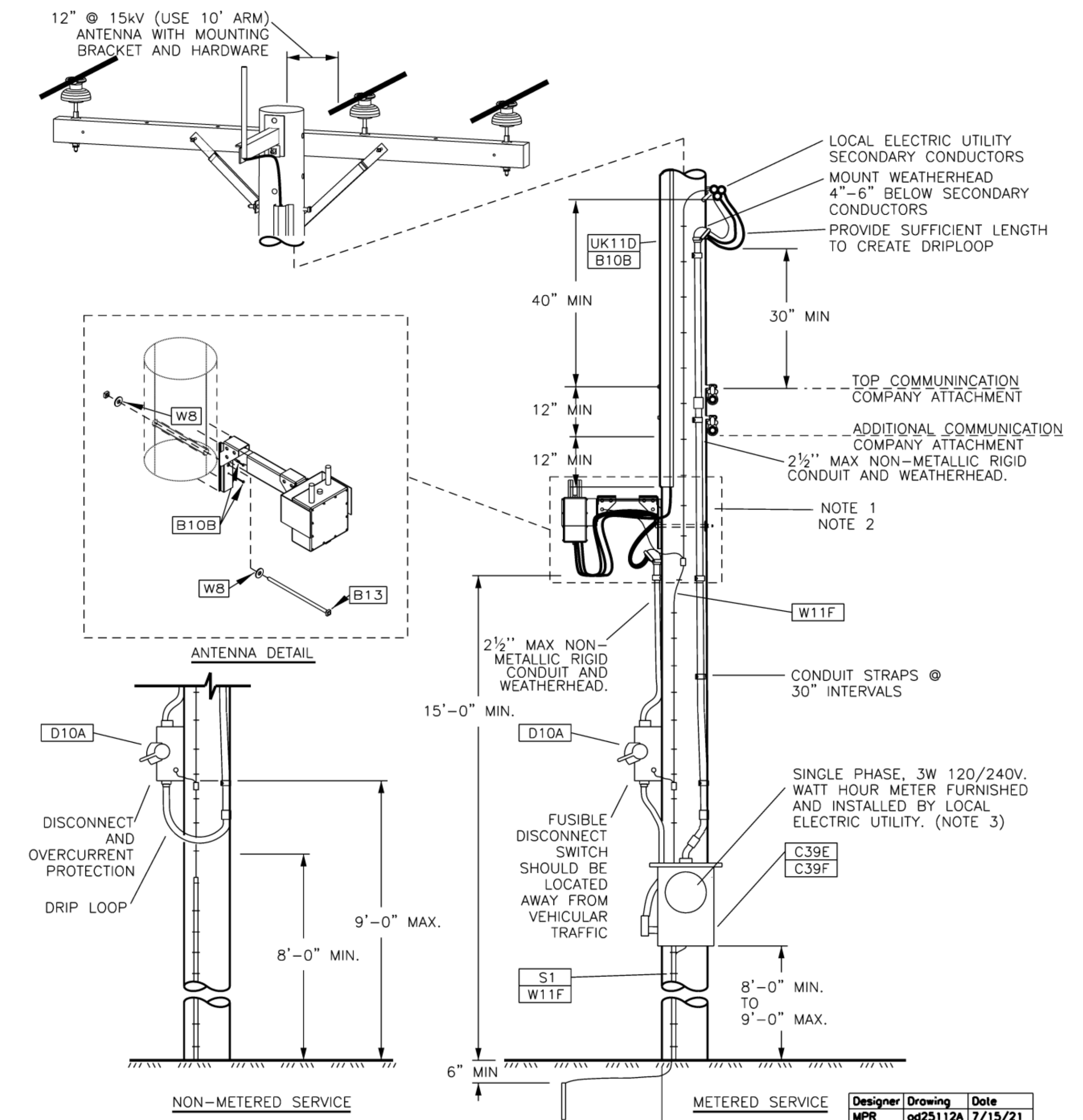
COMPANY INSTALLED NETWORK GATEWAY



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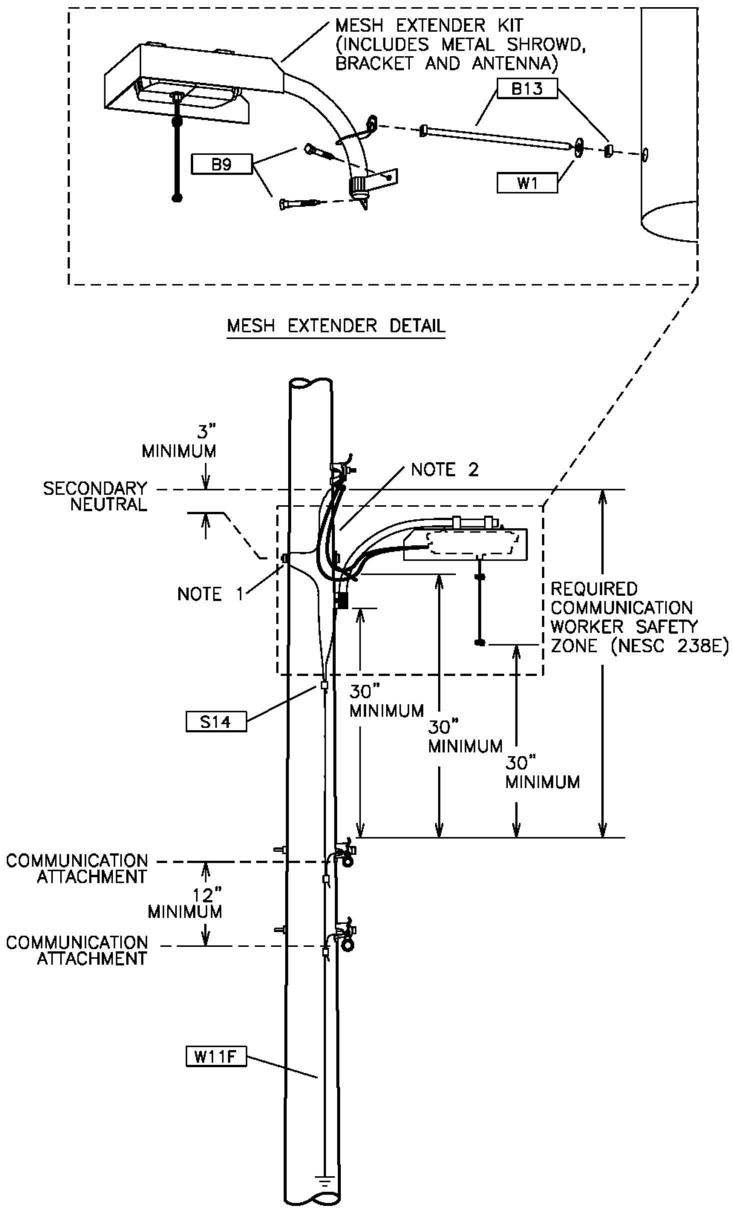
AMI GATEWAY INSTALL ON THIRD PARTY OWNED FOREIGN UTILITY

7/21 – New standard.

NETWORK GATEWAY WITH REMOTE SINGLE ANTENNA INSTALL ON THIRD PARTY OWNED FOREIGN UTILITY			
ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		25-112A	7/21

7/21 – New Standard

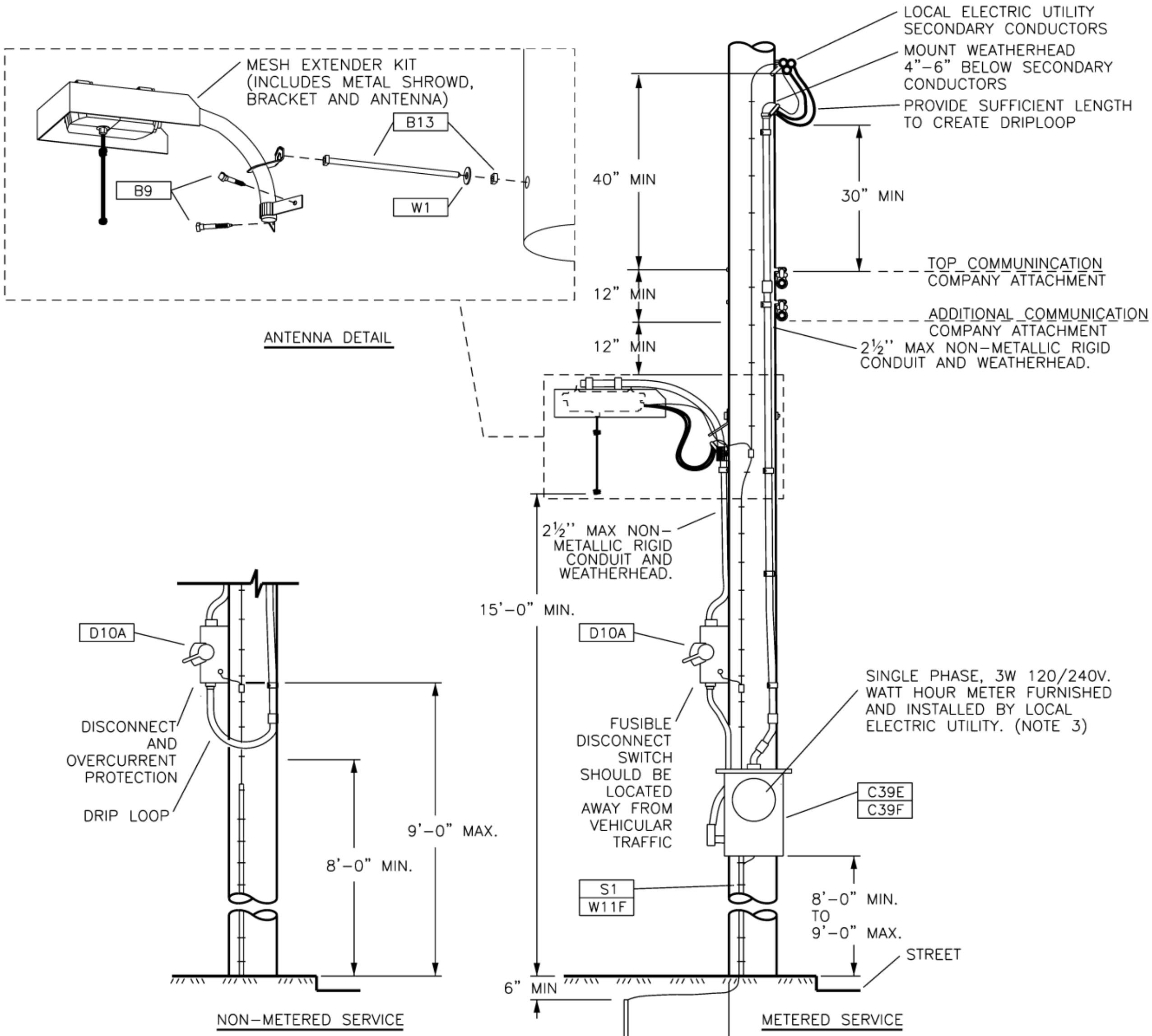


NOTES
1. SEE DRAWING 19-110 FOR GROUNDING REQUIREMENTS, AND SEE 13.3.40 FOR BONDING REQUIREMENTS.
2. SEE DRAWING 25-111 FOR IN-LINE FUSE DISCONNECT DETAIL.
3. THE PREFERRED ORIENTATION IS TO BE INSTALL MESH EXTENDER OVER ROADWAY TO MINIMIZE CLEARANCES, SEE SECTION 7.

Designer	Drawing	Date
MPR	od25113	6/25/21

COMPANY INSTALLED MESH EXTENDER

7/21 – New standard.



18"

NOTES:

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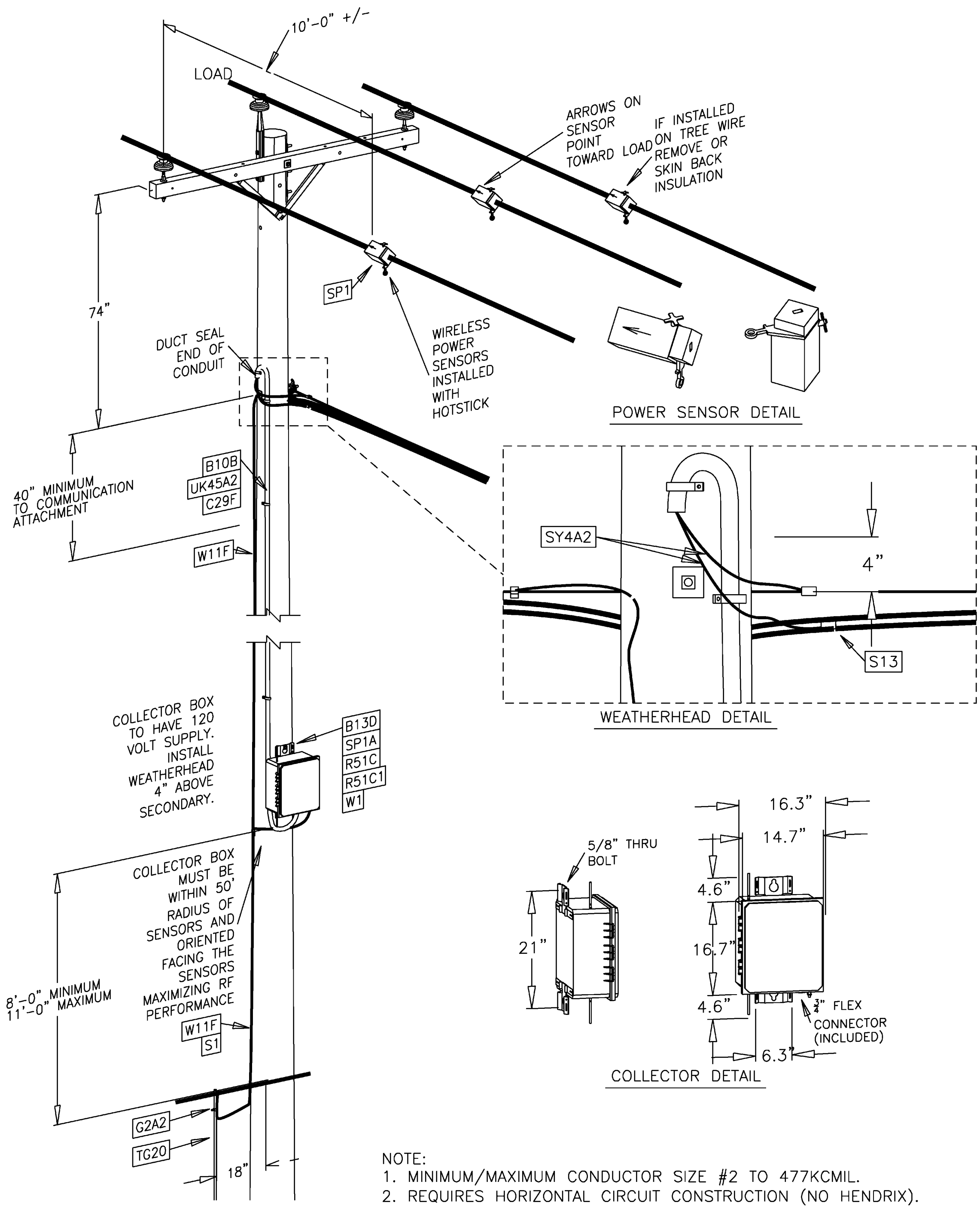
Designer	Drawing	Date
MPR	od25113A	7/15/21

MESH EXTENDER INSTALL ON THIRD PARTY OWNED FOREIGN UTILITY

MESH EXTENDER INSTALL ON THIRD PARTY OWNED FOREIGN UTILITY

ppl	OVERHEAD CONSTRUCTION STANDARD	PAGE NUMBER	ISSUE
		25-113A	7/21



NOTE:
1. MINIMUM/MAXIMUM CONDUCTOR SIZE #2 TO 477KCMIL.
2. REQUIRES HORIZONTAL CIRCUIT CONSTRUCTION (NO HENDRIX).

Designer	Drawing	Date
MPR	od25650	7/15/19

TYPICAL INSTALLATION OF POWER LINE SENSOR WITH COLLECTOR BOX

ISSUE	PAGE NUMBER		
7/19	25-650	OVERHEAD CONSTRUCTION STANDARD	ppl

Version	Date	Modification	Author(s)	Approval by (Name/Title)
3	7/21	• Added drawings 25-110, 25-110A, 25-111, 25-111A, 25-112, 25-112A, 25-113, and 25-113A	REDACTED	REDACTED
2	7/20	• Updated drawing 25-100 • Added drawing 25-100	REDACTED	REDACTED
1	7/19	• Created new standard	REDACTED	REDACTED