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<td>5111.02</td>
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</tbody>
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Note: The following Specifications are excerpts from the District’s Materials Catalog and therefore contain Specifications for items which the District is not soliciting Bids for at this time.
15 kV EPR Insulated, Jacketed, URD Cable

#2 & # 4/0 Aluminum Conductor with Concentric Neutral
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15 kV, #2 & # 4/0 ALUMINUM, EPR INSULATED, JACKETED, CONCENTRIC NEUTRAL URD CABLE

---

Material Specifications | Date: 12/21/2013 | J.Nieborsky | Standard No. 5110.0101  
Page 2 of 10
1 GENERAL

1.1 This Specification covers detail for furnishing medium voltage, jacketed, concentric neutral underground distribution power cable. The cable shall consist of one ethylene propylene rubber (EPR) insulated aluminum conductor, with helically applied copper concentric neutral conductors over the insulation shielding, and an overall jacket of black, linear low density polyethylene. The cable shall be 15 kV rated - suitable for use on 12470GrdY/7200 Volt primary underground distribution systems.

1.2 The cable shall be suitable for use in single, two, and three phase, primary underground distribution systems installed in underground ducts, above grade conduit, or direct burial in both wet or dry locations.

1.3 The cable shall be designed and constructed so that it will operate at normal operating temperatures of at least 90°C maximum, emergency operating temperatures of at least 130°C, and short circuit operating temperatures of at least 250°C. The cable shall be suitable for a minimum installation temperature of -40°C.

2 STANDARDS

2.1 All material and equipment furnished under these specifications shall conform to the latest NEMA, ICEA, AEIC, ANSI, and ASTM Standards.

2.2 Where the term “AEIC specification” is used, it shall mean AEIC Cable Specification No. CS8-07 for ethylene propylene rubber insulated cable.

2.3 Where the term “ICEA specification” is used, it shall mean ICEA – NEMA Standards Publication No. S-94-649 and S-93-639 for ethylene propylene rubber insulated cable.

3 APPROVED CABLE MANUFACTURERS

3.1 The District has approved and verified that the following manufacturers meet this Standard 5110.0101.

3.1.1 OKONITE

3.1.2 KERITE

4 REEL SPECIFICATIONS

4.1 The cable shall be packaged in lengths specified by the District with a tolerance of -0%/+5%.

4.2 The cable is to be packaged in approximately 2500-foot lengths on non-returnable reels with a maximum flange diameter of 50 inches for #2 and 58 inches for #4/0 cable. Each reel shall be marked with gross, tare and net weights, and cable footage.

4.3 Each end of the cable shall be firmly and properly secured to the reel. Care shall be taken to prevent looseness of reeled cable. The cable end attached through the interior of the reel shall be fastened in such a manner that it remains attached as the cable is dispensed from the reel and does not interfere with other reels or waste cable.

4.4 Reels shall be covered to provide protection of the outer layers against damage from normal handling and shipping. The covering shall be a Class 2 protection in accordance with NEMA.
4.5 Watertight seals shall be applied to all cable ends to prevent entry of moisture during transit and outside storage.

4.6 Reels shall be shipped upright on their flanges from the manufacturing plant to the District. Delivery to the District shall be on flatbed trucks. The District will offload the reel(s) from the flatbed.

4.7 Steel bushings shall be used to line the reel arbor holes if the gross weight exceeds 2500 pounds.

4.8 All cable larger than 4/0 must be supplied on metal reels, designed to be stored long term outdoors. Conductor on reels must be covered with a protective cover to keep cable safe from moisture and UV damage. Reels shall be free of foreign objects (nails, etc), sharp edges and burs that could damage the conductor during transit or while dispensing. Reel size shall be a minimum of 1 ½” larger than wound conductor.

5 PRODUCTION INFORMATION/ACCEPTANCE TESTS

5.1 At a minimum, Contractor shall provide production information as outlined on Exhibit A which information shall be submitted with each order delivery.

5.2 The District or its authorized agent may conduct performance tests on delivered cable. All test procedures, examinations and test results shall conform to AEIC CS8 and ICEA S-94-649 unless specifically noted. Test results that indicate a failure to satisfy the requirements of any section of this Specification may be a cause for rejection of that reel of cable.

5.3 Rejected cable shall be returned to the Contractor at Contractor’s expense and the District shall make no payment for the cable.

6 DISTRICT APPROVED EQUAL

6.1 The District will consider approved equals. The term "approved equal" shall mean that the quality and characteristics of equipment or materials are equal to or better than specified in this Standard.

6.2 Determination of Equality - The District will judge the suitability, reliability, and serviceability of a proposed substitute. To be considered by the District, the request for substitution shall be accompanied with complete physical and technical data, manufacturing information, manufacturer's catalog data, photographs, samples, test results, as well as the address of the nearest authorized service representative. The District shall be the sole arbiter in the determination of equality.

6.3 It is imperative that the District utilize cable that can be exchanged with other nearby utilities. Therefore, a qualified manufacturer shall have a customer base of at least 5 Pacific Northwest utilities. Bidder shall submit with the bid a current list of Pacific Northwest Utilities (minimum 5) that use the exact type of cable. Information included with these listings shall include total circuit feet of cable installed, number of years of service using this cable, and number of insulation failures recorded to date. Listings shall include contact persons and...
Bidder who bids a manufacturer not already approved by the District shall submit information with the bid to demonstrate compliance with this Specification as outlined below.

6.4.1 MANUFACTURING METHOD

6.4.1.1 Bidder shall provide with the bid a description of materials to be used in the manufacturing of the conductor shielding, insulation, insulation shielding, and cable jacket.

6.4.1.2 The conductor shield, insulation, and insulation shield shall be extruded on the central conductor with a single-pass triple extrusion or a two plus one process to prevent inter-surface contamination. The extrusion operation shall be performed by separate heads, thereby permitting the measurement and accurate control of the wall thickness of each individual layer as the cable is being manufactured.

6.4.1.3 All alterations to the critical process parameters of the extrusion line shall be noted in the production log.

6.4.1.4 The curing process shall employ a steam process.

6.4.1.5 A moisture free or water cooling process is acceptable.

6.4.2 CABLE CONSTRUCTION

6.4.2.1 Central Conductor- Conductors shall comply with the requirements of ICEA Standards. The central conductor shall be uncoated 1350 aluminum alloy. The aluminum rod from which the conductor is extruded shall be cleaned of contaminants and free of defects and corrosion. Stranded conductor shall be Class B concentric-lay, compressed 3% maximum, in accordance with ASTM B231 and ASTM B609.

6.4.2.2 Conductor Shielding- The conductor shield shall be a black, semi-conducting or stress grading material, extruded directly over the conductor. The strand shield material shall be compatible with the conductor and thoroughly bonded to the overlying insulation.

6.4.2.2.1 The shield material shall be clean stripping from the conductor. Its minimum thickness shall be in accordance with Table 3-1, ICEA S-94-649.

6.4.2.2.2 The contact surface between the conductor shielding and the insulation shall be cylindrical and free from protrusions and irregularities that extend more than 5 mils into the insulation and 7 mils into the conductor shielding. The conductor shield layer shall be free of any voids larger than 3 mils at the insulation interface.

6.4.2.2.3 The shielding material shall meet the physical requirements of Part 3, ICEA S-94-649. The conductor shielding shall not exceed the maximum volume resistivity values as outlined in ICEA S-94-649.

6.4.3 INSULATION

6.4.3.1 Bidder shall submit with the bid a description of the manufacturer and manufacturing process used to produce the insulation pellets and a statement as to how long this source of insulating compound has been used. Quality control procedures utilized in manufacturing shall also be included with this information.

6.4.3.2 The insulation shall be ethylene propylene rubber (EPR), a flexible thermosetting dielectric based on an ethylene propylene elastomer. The minimum average thickness of the insulation at any cross section along the cable length shall be either 175 or 220 mils depending upon District stock number. The minimum thickness at any point shall not be less than 90 percent of the specified minimum average thickness.

6.4.3.3 The insulation shall be extruded directly over and firmly bonded to the conductor shielding.
6.4.4 **INSULATION SHIELDING**

6.4.4.1 Bidder shall provide with the bid a description of the manufacturing process which shall include position of extruders, curing process, cooling process, pellet inspection, and pellet handling procedure.

6.4.4.2 The insulation shielding shall be a black, extruded, semi-conducting thermosetting or stress control layer of polymeric material extruded directly over the surface of the insulation. The material shall be completely compatible with the insulation and it shall meet the physical requirements of ICEA S-94-649.

6.4.4.3 The insulation shield shall be readily distinguishable from the insulation and shall be legibly identified as semi-conducting or stress control layer by surface printing. Indent printing shall not be allowed.

6.4.4.4 The minimum and maximum thickness of the insulation shielding shall be in accordance with ICEA S-94-649, 5-1.

6.4.4.5 Protrusions and irregularities shall not exceed 5 mils into the insulation and shall not exceed 7 mils into the insulation shielding. The insulation-shielding layer shall be free of any voids larger than 5 mils at the insulation interface.

6.4.4.6 The insulation shielding shall strip freely and cleanly from the underlying insulation using standard stripping tools. Any conductive material left after stripping shall be easily removable by wiping the insulation. If the shielding is semi-conducting, then the strippability shall conform to the requirements of ICEA S-94-649.

6.4.4.7 The concentric neutral wires indentation depth into the insulation shielding shall be no greater than the values listed in ICEA S-94-649, Table 5-1.

6.4.5 **CONCENTRIC NEUTRAL**

6.4.5.1 The concentric neutral conductor system shall consist of plain, uncoated, soft drawn solid copper wires and shall be applied directly over the insulation shield. The wires shall be helically wound on the cable, spaced equidistant from each other, and shall have a lay of six to ten times the outer diameter of one of the concentric neutral conductors.

6.4.5.2 Unless otherwise specified, the number and type of concentric neutral wires shall be according to the table below.

<table>
<thead>
<tr>
<th>Wire Size</th>
<th>Copper Wires</th>
</tr>
</thead>
<tbody>
<tr>
<td>#2 (7)</td>
<td>Full</td>
</tr>
<tr>
<td>4/0 (19)</td>
<td>1/3</td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>#14</td>
</tr>
<tr>
<td></td>
<td>#14</td>
</tr>
</tbody>
</table>

6.4.6 **OVERALL OUTER JACKET**

6.4.6.1 A black, linear low-density polyethylene (thermoplastic) jacket, extruded-to-fill type, shall be placed directly over the concentric neutral conductors.

6.4.6.2 The nominal thickness of the jacket shall be 50 mils and shall not be less than 90 percent of this value at any place on the cable. The jacket shall be free stripping and suitable for exposure to sunlight and extreme temperatures. The overall outer jacket shall meet the requirements of ICEA S-94-649.
6.4.6.3 The outer jacket shall be manufactured such that the concentric neutral wires remain equally spaced and in contact with the underlying extruded insulation shielding, leaving no voids after application.

6.4.7 IDENTIFICATION

6.4.7.1 The center strand of stranded conductor cable shall be indent printed with the manufacturer’s name and year of manufacture at regular intervals with no more than 12 inches between repetitions as per ICEA S-94-649.

6.4.7.2 The outer surface of the jacket of each cable shall be clearly and permanently marked throughout its length in accordance with ICEA S-94-649, Part 8. Stamped markings denoting the conductor size, conductor metal, voltage class, insulation type and thickness, date of manufacture, and name of manufacturer, shall be included on the surface of the jacket. A lightning bolt symbol in accordance with NESC (Rule 350) shall be included in the identification marking.

6.4.7.3 Sequential footage numbers shall be clearly and permanently marked throughout the cable at 2-foot intervals. The depth of the indentation shall be a minimum of 1 mil and a maximum of 15% of the jacket thickness.

6.4.7.4 The outer surface of the jacket of each cable shall be marked with three extruded, continuous, longitudinal, highly visible opaque red stripes spaced 120° apart. The dimensions of the stripes shall be 0.2 to 0.4 inches wide.

6.4.8 TESTING BY THE MANUFACTURER

6.4.8.1 Conditions applying to tests shall be in accordance with ICEA 94-649.

6.4.8.2 Bidder shall submit with the bid documentation of successfully passing an accelerated cable life test (ACLT) such as the EPRI/CPI protocol, or other District approved independent testing protocol, for at least 1000 days with no cable failures.

6.4.8.3 Qualification Tests

6.4.8.3.1 A certified copy of the results of Core Material Qualification Tests shall be provided with the bid. Cable with a # 1/0 conductor size is the preferred size for the qualification tests.

6.4.8.3.2 Alternate qualifications tests must be approved by the District.

6.4.8.4 Production Sampling Tests

6.4.8.4.1 The manufacturer shall provide with the bid Production Sampling Tests results in accordance with ICEA S-94-649, Table 9-5 and shall include testing of the following:

a) conductor
b) non-metallic conductor shield
c) insulation
d) non-metallic insulation shield
e) jacket
f) electrical tests
g) moisture tests

6.4.8.4.2 Alternate production tests shall be approved by the District.

7 WARRANTY

7.1 The manufacturer shall warrant that the cable furnished under this specification will be free
from defects in material, design, and workmanship for a minimum of 40 (forty) years after purchase. In the event of a cable failure within the 40 year period, the manufacturer will be responsible for promptly providing replacement cable for the failed section of cable, unless it can be demonstrated to the District’s satisfaction that the failure was not due to a manufacturing defect or design inadequacy.
## APPENDIX 1

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<th>Manufacturer:</th>
<th>Cable Size:</th>
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1. Location of manufacturing plant  
2. No. & size (AWG) of drain wires  
3. Central conductor stranding  
4. Aluminum Base Price:  
5. Copper Base Price:  
6. Metal Content in Cable:  
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<th>Copper:</th>
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<tr>
<td>lbs/1000ft</td>
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<tr>
<td>Lead:</td>
<td>Steel:</td>
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<tr>
<td>lbs/1000ft</td>
<td>lbs/1000ft</td>
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7. Outside Diameter: Over Insulation  |
8. Weight of complete cable  
9. Type & Thickness of Insulation  
10. Insulation compound  
11. Polyethylene content of insulation  
12. Minimum thickness and maximum thickness  
   | Min:  | Max:  |
   | _____ | _____ |
13. Minimum average thickness for the conductor  
   | shielding, insulation and insulation shielding  
14. Minimum thickness and maximum thickness  
   | for the jacket  
15. Minimum diameter and maximum diameter  
   | for the insulation, insulation shielding and jacket  
16. Reel size  
17. Flange & Drum diameters/overall width  
18. Length of cable on reel  
19. Recommended pulling tensions  
20. Minimum Bending Radius  
21. Cable Ampacity (cite Mfg. Assumptions)  

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**Material Specifications**  
15 kV, #2 & # 4/0 ALUMINUM, EPR INSULATED, JACKETED, CONCENTRIC NEUTRAL URD CABLE  

**Date:** 12/21/2013  
**J.Nieborsky**  
**Standard No.:** 5110.0101  
**Page:** 9 of 10
22. Deviations from Specifications (indicate “none” if no deviations):

________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
15 kV EPR Insulated, Jacketed, URD Cable

1000 kcm Aluminum Conductor with Tape Shield
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**Material Specifications**

Date 12/21/2013  J.Nieborsky

Standard No. 5110.0103

15 KV, 1000KCMIL ALUMINUM, EPR INSULATED, SHIELDED, JACKETED, UNDERGROUND POWER CABLE

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Page 2 of 11
1 GENERAL

1.1 This specification covers detail for furnishing medium voltage, jacketed, shielded underground distribution power cables. The cables shall consist of one ethylene propylene rubber (EPR) insulated aluminum conductor, with a helically applied copper tape shield over the insulation shielding, and an overall jacket of black, linear low density polyethylene. The cables shall be 15 kV rated - suitable for use on 12470GrdY/7200 Volt primary underground distribution systems.

1.2 The cables shall be suitable for use in single, two, and three phase, primary underground distribution systems installed in underground ducts, above grade conduit, or direct burial in both wet or dry locations.

1.3 The cable shall be designed and constructed so that it will operate at normal operating temperatures of at least 90ºC maximum, emergency operating temperatures of at least 130ºC, and short circuit operating temperatures of at least 250ºC. The cable shall be suitable for a minimum installation temperature of -40ºC.

2 STANDARDS

2.1 All material and equipment furnished under these specifications shall conform to the latest NEMA, ICEA, AEIC, ANSI, and ASTM Standards.

2.2 Where the term “AEIC specification” is used, it shall mean AEIC Cable Specification No. CS6-87 for ethylene propylene rubber insulated cable

2.3 Where the term “ICEA specification” is used, it shall mean ICEA – NEMA Standards Publication No. S-97-682 and S-93-639 for ethylene propylene rubber insulated cable.

3 APPROVED CABLE MANUFACTURERS

3.1 The District has approved and verified that the following manufacturers meet this Standard 5110.0103.

3.1.1 OKONITE

3.1.2 KERITE

4 REEL SPECIFICATIONS

4.1 The cable shall be packaged in lengths specified by the District with a tolerance of -0%+/5%.

4.2 The cable is to be packaged in approximately 2000-foot lengths on non-returnable reels with a maximum flange diameter of 82 inches for 1000kcm Cable. Each reel shall be marked with gross, tare and net weights, and cable footage.

4.3 Each end of the cable shall be firmly and properly secured to the reel. Care shall be taken to prevent looseness of reeled cable. The cable end attached through the interior of the reel shall be fastened in such a manner that it remains attached as the cable is dispensed from the reel and does not interfere with other reels or waste cable.

4.4 Reels shall be covered to provide protection of the outer layers against damage from normal handling and shipping. The covering shall be a Class 2 protection in accordance with NEMA
4.5 Watertight seals shall be applied to all cable ends to prevent entry of moisture during transit and outside storage.

4.6 Reels shall be shipped upright on their flanges from the manufacturing plant to the District. Delivery to the District shall be on flatbed trucks. The District will offload the reel(s) from the flatbed.

4.7 Steel bushings shall be used to line the reel arbor holes if the gross weight exceeds 2500 pounds.

4.8 All cable larger than 4/0 must be supplied on metal reels, designed to be stored long term outdoors. Conductor on reels must be covered with protective cover to keep cable safe from moisture and UV damage. Reels shall be free of foreign objects (nails, etc.) sharp edges and burs that could damage the conductor during transit or while dispensing. Reel size shall be a minimum of 1 ½” larger than wound conductor.

5 PRODUCTION INFORMATION/ACCEPTANCE TESTS

5.1 At a minimum, Contractor shall provide production information as outlined on Exhibit A which information shall be submitted with each order delivery.

5.2 The District or its authorized agent may conduct performance tests on delivered cable. All test procedures, examinations and test results shall conform to AEIC CS8 and ICEA S-97-682 unless specifically noted. Test results that indicate a failure to satisfy the requirements of any section of this Specification may be a cause for rejection of that reel of cable.

5.3 Rejected cable shall be returned to the Contractor at Contractor’s expense and the District shall make no payment for the cable.

6 DISTRICT APPROVED EQUAL

6.1 The District will consider approved equals. The term "approved equal" shall mean that the quality and characteristics of equipment or materials are equal to or better than specified in this Standard.

6.2 Determination of Equality - The District will judge the suitability, reliability, and serviceability of a proposed substitute. To be considered by the District, the request for substitution shall be accompanied with complete physical and technical data, manufacturing information, manufacturer's catalog data, photographs, samples, test results, as well as the address of the nearest authorized service representative. The District shall be the sole arbiter in the determination of equality.

6.3 It is imperative that the District utilize cable that can be exchanged with other nearby utilities. Therefore, a qualified manufacturer shall have a customer base of at least 5 Pacific Northwest utilities. Bidder shall submit with the bid a current list of Pacific Northwest Utilities (minimum 5) that use the exact type of cable. Information included with these listings shall include total circuit feet of cable installed, number of years of service using this cable, and number of insulation failures recorded to date. Listings shall include contact persons and telephone numbers.

6.4 Bidder who bids a manufacturer not already approved by the District shall submit information
with the bid to demonstrate compliance with this Specification as outlined below.

6.4.1 MANUFACTURING METHOD

6.4.1.1 Bidder shall provide with the bid a description of materials to be used in the manufacturing of the conductor shielding, insulation, insulation shielding, and cable jacket.

6.4.1.2 The conductor shield, insulation, and insulation shield shall be extruded on the central conductor with a single-pass triple extrusion or a two plus one process to prevent inter-surface contamination. The extrusion operation shall be performed by separate heads, thereby permitting the measurement and accurate control of the wall thickness of each individual layer as the cable is being manufactured.

6.4.1.3 All alterations to the critical process parameters of the extrusion line shall be noted in the production log.

6.4.1.4 The curing process shall employ a steam process.

6.4.1.5 A moisture free or water cooling process is acceptable.

6.4.2 CABLE CONSTRUCTION

6.4.2.1 Central Conductor-Conductors shall comply with the requirements of ICEA Standards. The central conductor shall be uncoated 1350 aluminum alloy. The aluminum rod from which the conductor is extruded shall be cleaned of contaminants and free of defects and corrosion. Stranded conductor shall be Class B concentric-lay, compressed 3% maximum, in accordance with ASTM B231 and ASTM B609.

6.4.2.2 Conductor Shielding-The conductor shield shall be a black, semi-conducting or stress grading material, extruded directly over the conductor. The strand shield material shall be compatible with the conductor and thoroughly bonded to the overlying insulation.

6.4.2.2.1 The shield material shall be clean stripping from the conductor. Its minimum thickness shall be in accordance with Table 3-1, ICEA S-97-682.

6.4.2.2.2 The contact surface between the conductor shielding and the insulation shall be cylindrical and free from protrusions and irregularities that extend more than 5 mils into the insulation and 7 mils into the conductor shielding. The conductor shield layer shall be free of any voids larger than 3 mils at the insulation interface.

6.4.2.2.3 The shielding material shall meet the physical requirements of Part 3, ICEA S-97-682. The conductor shielding shall not exceed the maximum volume resistivity values as outlined in ICEA S-97-682.

6.4.3 INSULATION

6.4.3.1 Bidder shall submit with the bid a description of the manufacturer and manufacturing process used to produce the insulation pellets and a statement as to how long this source of insulating compound has been used. Quality control procedures utilized in manufacturing shall also be included with this information.

6.4.3.2 The insulation shall be ethylene propylene rubber (EPR), a flexible thermosetting dielectric based on an ethylene propylene elastomer.
6.4.3.3 The minimum average thickness of the insulation at any cross section along the cable length shall be either 175 or 220 mils depending upon District stock number. The minimum thickness at any point shall not be less than 90 percent of the specified minimum average thickness.

6.4.3.4 The insulation shall be extruded directly over and firmly bonded to the conductor shielding.

6.4.4 Insulation Shielding

6.4.4.1 Bidder shall provide with the bid a description of the manufacturing process which shall include position of extruders, curing process, cooling process, pellet inspection, and pellet handling procedure.

6.4.4.2 The insulation shielding shall be a black, extruded, semi-conducting thermosetting or stress control layer of polymeric material extruded directly over the surface of the insulation. The material shall be completely compatible with the insulation and it shall meet the physical requirements of ICEA S-97-682.

6.4.4.3 The insulation shield shall be readily distinguishable from the insulation and shall be legibly identified as semi-conducting or stress control layer by surface printing. Indent printing shall not be allowed.

6.4.4.4 The minimum and maximum thickness of the insulation shielding shall be in accordance with ICEA S-97-682, 5-1.

6.4.4.5 Protrusions and irregularities shall not exceed 5 mils into the insulation and shall not exceed 7 mils into the insulation shielding. The insulation-shielding layer shall be free of any voids larger than 5 mils at the insulation interface.

6.4.4.6 The insulation shielding shall strip freely and cleanly from the underlying insulation using standard stripping tools. Any conductive material left after stripping shall be easily removable by wiping the insulation. If the shielding is semi-conducting, then the strip ability shall conform to the requirements of ICEA S-97-682.

6.4.5 Metallic Shielding

6.4.5.1 A 5-mil copper tape shield with a minimum overlap of 20% shall be helically applied over the insulation shield in accordance with ICEA S-97-682.

6.4.6 Overall Outer Jacket

6.4.6.1 A black, linear low-density polyethylene (thermoplastic) jacket, extruded-to-fill type, shall be placed directly over the helically wound tape shield.

6.4.6.2 The nominal thickness of the jacket shall be 80 mils and shall not be less than 80 percent of this value at any place on the cable. The jacket shall be free stripping and suitable for exposure to sunlight and extreme temperatures. The overall outer jacket shall meet the requirements of ICEA S-97-682.

6.4.6.3 The outer jacket shall be manufactured such that the overlaps of the metallic tape shield remain equally spaced and in contact with the underlying extruded insulation shielding, leaving no voids after application.
6.4.7 IDENTIFICATION

6.4.7.1 The center strand of stranded conductor cable shall be indent printed with the manufacturer’s name and year of manufacture at regular intervals with no more than 12 inches between repetitions as per ICEA S-97-682.

6.4.7.2 The outer surface of the jacket of each cable shall be clearly and permanently marked throughout its length in accordance with ICEA S-97-682, Part 8. Stamped markings denoting the conductor size, conductor metal, voltage class, insulation type and thickness, date of manufacture, and name of manufacturer, shall be included on the surface of the jacket. A lightning bolt symbol in accordance with NESC (Rule 350) shall be included in the identification marking.

6.4.7.3 Sequential footage numbers shall be clearly and permanently marked throughout the cable at 2-foot intervals. The depth of the indentation shall be a minimum of 1 mil and a maximum of 15% of the jacket thickness.

6.4.7.4 The outer surface of the jacket of each cable shall be marked with three extruded, continuous, longitudinal, highly visible opaque red stripes spaced 120° apart. The dimensions of the stripes shall be 0.2 to 0.4 inches wide.

6.4.8 TESTING BY THE MANUFACTURER

6.4.8.1 Conditions applying to tests shall be in accordance with ICEA S-97-682.

6.4.8.2 Bidder shall submit with the bid documentation of successfully passing an accelerated cable life test (ACLT) such as the EPRI/CPI protocol, or other District approved independent testing protocol, for at least 1000 days with no cable failures.

6.4.8.3 Qualification Tests

6.4.8.3.1 A certified copy of the results of Core Material Qualification Tests shall be provided with the bid. Cable with a # 1/0 conductor size is the preferred size for the qualification tests.

6.4.8.3.2 Alternate qualifications tests must be approved by the District.

6.4.8.4 Production Sampling Tests

6.4.8.4.1 The manufacturer shall provide with the bid Production Sampling Tests results in accordance with ICEA S-97-682, Table 9-5 and shall include testing of the following:
   a) conductor
   b) non-metallic conductor shield
   c) insulation
   d) non-metallic insulation shield
   e) jacket
   f) electrical tests
   g) moisture tests

6.4.8.4.2 Alternate production tests shall be approved by the District.
7 CABLE DAMAGE DATA

7.1 Cable damage curves shall be provided for the following cases. In all cases the cable shield will be grounded at each end of any run.

7.1.1 Six 1000 kcmil aluminum primary cable and two 350 kcmil aluminum neutral cable, one in each of eight separate 3” nonmetallic underground conduit runs. The conduit runs shall be configured four ducts across and two ducts high. An ambient earth temperature of 20°C will be used in the calculation along with a duct spacing of 5.25” centerline to centerline on the horizontal axis and a 5.01” duct spacing centerline to centerline on the vertical axis. The phasing is shown below.

```
A  B  C  N
C  B  A  N
```

7.1.2 Three 1000 kcmil aluminum primary cable and one 350 kcmil aluminum neutral cable, one in each of four separate 3” nonmetallic underground conduit runs. The conduit runs shall be configured four ducts across and one duct high. An ambient earth temperature of 20°C will be used in the calculation along with a duct spacing of 5.25” from centerline to centerline. The phasing is shown below.

```
A  B  C  N
```

7.1.3 Three 1000 kcmil aluminum primary cable and one 350 kcmil aluminum neutral cable, one in each of four separate 3” nonmetallic risers. The riser is attached to a pole located in free air. The risers shall be in rectangular configuration with one riser located at each point of the rectangle. A spacing of 2” shall be utilized between the outside of each riser. No wind shall be used in this calculation and the ambient temperature shall be 30°C. The phasing is shown below.

```
C  B  
A  N
```

7.2 The data shall be plotted as time versus current on log-log graph paper where time shall be in seconds and current in amperes. The time values shall be shown on the vertical axis and the current values shown on the horizontal axis. The first data point shall be for a time of 300 seconds and the last data point for a current of 12,000 amperes.

8 WARRANTY

8.1 The manufacturer shall warrant that the cable furnished under this specification will be free
from defects in material, design, and workmanship for a minimum of 40 (forty) years after purchase. In the event of a cable failure within the 40 year period, the manufacturer will be responsible for promptly providing replacement cable for the failed section of cable, unless it can be demonstrated to the District’s satisfaction that the failure was not due to a manufacturing defect or design inadequacy.
## APPENDIX 1

Manufacturer: ______________  Cable Size: ______________

1. Location of manufacturing plant

2. No. & size (AWG) of drain wires

3. Central conductor stranding


5. Copper Base Price: ______________ $/lb.

6. Metal Content in Cable:

<table>
<thead>
<tr>
<th>Material</th>
<th>lbs/1000ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
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<tr>
<td>Copper</td>
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</tr>
<tr>
<td>Lead had to be used</td>
<td></td>
</tr>
<tr>
<td>Steel had to be used</td>
<td></td>
</tr>
</tbody>
</table>

7. Outside Diameter: Over Insulation ___________ Complete Cable ___________ Inches.

8. Weight of complete cable ______________ Lbs. /1000 Ft.

9. Type & Thickness of Insulation _______ ____________ Inches.

10. Insulation Compound

11. Polyethylene content of insulation ______________ % by weight

12. Minimum thickness and maximum thickness Min: _____ Max: ______

13. Minimum average thickness for the conductor shielding, insulation and insulation shielding

14. Minimum thickness and maximum thickness for the jacket

15. Minimum diameter and maximum diameter for the insulation, insulation shielding and jacket

16. Reel size

17. Flange & Drum diameters/overall width

18. Length of cable on reel ______________ Feet

19. Recommended pulling tensions ______________ Lbs

20. Minimum Bending Radius ______________ Inches

21. Series Resistance of Cable Per Phase @ 75°C ______________ Ω/1000 Ft.

22. Series Reactance of Cable Per Phase @ 75°C 60Hz ______________ Ω/1000 Ft.

Spacing between Cable, 5.25”
23. **Cable Ampacity** (For Three Different Cases Described in Section 8 of this spec).
Conductor Temperature, 105°C, 100% Load Factor, Ambient Earth Temperature 20°C, Soil
Thermal Resistivity RHO-90

| Case 8.1.1 | __________ Amps | Case 8.1.2 | __________ Amps |
| Case 8.1.3 | __________ Amps |

24. **Cable Ampacity Adjustment Factors**
1. Ambient Earth Temperature of 14°C, Adjustment Factor = ______________
2. Ambient Earth Temperature of 8°C, Adjustment Factor = ______________
3. Ambient Earth Temperature of 0°C, Adjustment Factor = ______________

25. **Deviations from Specifications** (indicate “none” if no deviations):
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
Application: 600 volt underground service cable shall be used for secondaries and services in conduit or direct buried, in wet or dry locations.

Specification:
This 600 volt secondary URD cable shall meet or exceed the following applicable ASTM specifications:

**Aluminum**
- B-231 Aluminum 1350 Conductors, Concentric-Lay-Stranded.
- B-609 Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes.
- B-901 Compressed Round Stranded Aluminum Conductors Using Single Input Wire.

**Copper:**
- B-1 Hard-Drawn Copper Wire.
- B-3 Soft or Annealed Copper Wire.
- B-8 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

In addition, this 600 volt secondary URD cable shall meet or exceed all applicable requirements of ICEA S-105-692 for cross-linked polyethylene insulated conductors and UL Standard 854 for Type USE-2.

**Cable Assembly:** The conductors of multiple conductor cables shall be twisted together with a lay of not greater than 60 times the outside diameter of an insulated phase conductor. Each conductor of a cable shall have a permanent continuous marking, identifying it from other conductors of the cable, and showing the manufacturer’s name or trademark, year of manufacture, voltage rating, conductor size, type of insulation and NEC type “USE-2.”

As a minimum, triplex cables shall have one phase conductor marked with "Phase A" identification. Footage markers on the conductor insulation is required. Sequential footage markers may be located on either phase conductor or neutral.
As a minimum, quadruple cables shall have one phase conductor marked with "Phase A" identification, a second phase conductor marked with "Phase B" identification. Sequential footage markers may be located on any phase conductor or the neutral.

**Packaging and Marking:** Cable shall be shipped on nonreturnable reels of NEMA WC26 dimensions with in either "cut to order" or standard lengths as specified. Conductor shall be level wound on reel. Both ends of the wire shall be fastened to the reel. Conductor shall be protected by heavy wrapping, either heavy fiberboard or 10 mil. plastic. The net weight, length, conductor size and kind, stranding, voltage class, purchaser’s order number, and manufacturer’s name, address, starting footage of the cable (at the hub), and serial number shall be marked on a durable label or tag and securely fastened to the outside of the reel.

Reels shall be free of foreign objects (nails, etc.) that could damage the conductor during transit or while dispensing. Reel size shall be a minimum of 1-1/2” larger than wound conductor. Reels shall not exceed maximum flange diameter of 66 inches nor a maximum outside width of 32-1/2 inches. The arbor hole shall have a diameter of 2-1/2 inches.

**Shipping:** All cable shall be shipped on an open flatbed truck. Reel flanges shall be vertical and positioned to be unloaded from the side. The cable shall be protected by heavy wrapping, either heavy fiberboard or 10 mil plastic. All cable ends shall be sealed with approved end caps to prevent the entrance of moisture during shipping and storage.

**Tests:** The cable shall be tested in accordance with the applicable requirements of ICEA Publication No. S-105-692 (latest revision) except "sparking testing" shall not be permitted. Results of these tests shall be supplied to the Standards Engineer prior to shipping if requested.

**Inspection:** Inspection may be made at the manufacturer’s plant or upon receipt, at the option of the purchaser. Failure to meet any of the requirements of this specification will be cause for rejection.
## Approved Manufacturers: CME, Southwire, BI CC General (Formerly Alcan), & Nexans

<table>
<thead>
<tr>
<th>Stock No</th>
<th>Description</th>
<th>Dia. (inches)</th>
<th>*Amps/Phase (INDUCT)</th>
<th>Wt. Per 1000 Ft (lbs)</th>
<th>Reel Feet - 0 +10%</th>
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<tr>
<td>051750</td>
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<td>1100</td>
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</tbody>
</table>

*Ampacity: 90°C conductor temperature, 20°C ambient, RHO 90, 100% load factor for three conductor triplex with neutral carrying only unbalanced load.*
**Application:**
600 volt overhead aluminum service cable shall be used for secondaries and services to serve electric loads.

**Common Name:** Overhead Secondary Wire

**Specification:** 600 volt overhead concentric or compressed aluminum XLPE insulated cable, shall meet the following requirements.

**Material:** Cable shall be manufactured per latest revision of ICEA S-61-402 and shall consist of one or more insulated conductors twisted around a bare ACSR neutral supporting conductor. Cable shall be suitable for normal continuous operation at 75 degrees C without damage.

**Packaging and Marking:** The net weight, length, conductor size and name, voltage class, purchaser’s order number and manufacturer’s name, address, and serial number shall be marked on a durable label and securely fastened to the outside of the reel or coil. *Reels shall be of NEMA WC26 dimensions and free of foreign objects (nails, etc.) that could damage the conductor during transit or while dispensing. Quadruplex conductor must have extruded ridge for phase identification. The cable assemblies shall bear the following surface markings at intervals not to exceed 24 inches: Manufacturers Name, Plant of Manufacture, XLPE, Year of Manufacture, and cable footage.*

**Shipping:** All cable shall be shipped on an open flatbed truck. Reel flanges shall be vertical and positioned to be unloaded from the side. The cable shall be tarped or each reel shall be individually wrapped during shipment. Cable shall be shipped (on nonreturnable reels/in coils) with one continuous length.

**Approved Manufacturers:** CME, NEXANS, SOUTHWIRE & BICC GENERAL (Formerly Alcan)

---

**Item No** | **Description** | **Wt (lbs/1000ft)** | **Amps/Phase** | **Reel Size** | **Reel Wt (Lbs)** | **Reel (Ft.)**
---|---|---|---|---|---|
034400 | CABLE, OH, 600V, #4 ACSR, DUPLEX, "TERRIER", HAND COIL, XLPE | 115 | 115 | Coil Only | 60 | 500 | 034500 | CABLE, OH, 600V, #2 AL, TRIPLEX, "COCKLE", HAND COIL, XLPE | 228 | 150 | Coil Only | 114 | 500 | 034420 | CABLE, OH, 600V, #2 AL, TRIPLEX, "COCKLE" XLPE | 228 | 150 | 36"x27.5"x1.5" | 420 | 1800 | 034440 | CABLE, OH, 600V, #2/0 AL, TRIPLEX, "CAVOLINIA", 1500, XLPE | 453 | 235 | 42"x30"x1.5" | 698 | 1500 | 034470 | CABLE, OH, 600V, #4/0 AL, TRIPLEX, "CERAPUS", XLPE | 681 | 315 | 50"X36.5X2" | 704 | 1000 | 034490 | CABLE, OH, 600V, #2 AL, QUADRAPLEX, "PALOMINO", XLPE | 347 | 135 | 42"X30"X2" | 660 | 1800 | 034540 | CABLE, OH, 600V, #2/0 AL, QUADRAPLEX, "GRULLO", XLPE | 677 | 210 | 49"X36"X2" | 1060 | 1500 | 034550 | CABLE, OH, 600V, #4/0 AL, QUADRAPLEX, "APPALOOSA", XLPE | 1038 | 280 | 50"X36"X2" | 1070 | 1000
Application: Used as bare overhead transmission cable and as primary and secondary distribution cable. ACSR offers optimal strength for line design. Variable steel core stranding enables desired strength to be achieved without sacrificing ampacity.

Common Name: ACSR Overhead Wire

Specification:
The ACSR bare conductor shall meet or exceed the following ASTM specifications for right hand lay stranding.
- B-230 Aluminum Wire, 1350-H19 for Electrical Purposes
- B-231 Aluminum Conductors, Concentric-Lay-Stranded
- B-232 Aluminum Conductors, Concentric-Lay-Stranded, Coated Steel Reinforced (ACSR)
- B-341 Aluminum-Coated Steel Core Wire for Aluminum Conductors, Steel Reinforced (ACSR/AZ)
- B-498 Zinc-Coated Steel Core Wire for Aluminum Conductors, Steel Reinforced (ACSR)
- ANSI C7.69 Non-Specular Finish

Actual lengths shall conform to wood reels supplied by the manufacturer and shall be minus 0% or plus 15%. All wire shall have a non specular surface finish.

Packaging and Marking: The net weight, length, conductor size and name, purchaser's order number and manufacturer's name, address, and serial number shall be marked on a durable label and securely fastened to the outside of the reel or coil. Reels shall be of NEMA WC26 dimensions and free of foreign objects (nails, etc.) that could damage the conductor during transit or while dispensing. See table for reel sizes and wire lengths.

Shipping: All cable shall be shipped on an open flatbed truck. Reel flanges shall be vertical and positioned to be unloaded from the side. All reels shall have a protective wrap. Wire shall be shipped on nonreturnable reels with one continuous length. DO NOT LAY REELS ON THEIR SIDES.

Approved Manufacturers: Southwire & BiCC General (Formerly Alcan)

<table>
<thead>
<tr>
<th>Item No</th>
<th>Maximo Description</th>
<th>Wire Lbs/Kft</th>
<th>REEL Information</th>
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*NR = Non-Returnable Wooden Reel, RMT = Returnable, Steel Reels, Deposit Required.
NR 66.28** Only for maintenance repairs, normally ordered on RMT reels on a project basis.
Application:
AAC Wire is used primarily for overhead transmission and primary and secondary distribution, where Ampacity must be maintained and a lighter conductor (compared to ACSR) is desired, when conductor strength is not a critical factor.

Common Name: AAC Overhead Wire

Specification:
The AAC bare conductor shall meet or exceed the following ASTM specifications for right hand lay stranding.
• B-230 Aluminum Wire, 1350-H19 for Electrical Purposes.
• B-231 Aluminum Conductors, Concentric-Lay-Stranded.
• C7.69 Non-Specular Surface Finish.

Construction:
Aluminum alloy 1350-H19 wires, concentrically stranded, non-specular finish.

Actual lengths shall conform to wood reels supplied by the manufacturer and shall be minus 0% or plus 15%.

Packaging and Marking: The net weight, length, conductor size and name, purchaser's order number and manufacturer's name, address, and serial number shall be marked on a durable label and securely fastened to the outside of the reel or coil. *Reels shall be of NEMA WC26 dimensions and free of foreign objects (nails, etc.) that could damage the conductor during transit or while dispensing. See table for reel sizes and wire lengths.

Shipping: All cable shall be shipped on an open flatbed truck. Reel flanges shall be vertical and positioned to be unloaded from the side. All reels shall have a protective wrap. Wire shall be shipped on nonreturnable reels with one continuous length. DO NOT LAY REELS ON THEIR SIDES.

Approved Manufacturers: Southwire, Nexans & BICC General (Formerly Alcan)

<table>
<thead>
<tr>
<th>Item No</th>
<th>Maximo Description</th>
<th>Wire Lbs/Kft</th>
<th>REEL Information</th>
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</table>

*NR = Non-Returnable Wooden Reel, RMT = Returnable, Steel Reels, Deposit Required.
NR 66.28** Only for maintenance repairs, normally ordered on RMT reels on a project basis.