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| **SPECIFICATION**  **FOR**  Aluminum, Al-clad steel-reinforced (ACSR/AW) Conductor  And XLPE Insulation for working voltage 13.2kV to 23kV  (ACST/AW-TR/OC for 13.2kV to 23kV-Y) | | | | | |
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| A | Feb. 26, 2016 | First issue | Engineer | Director | Deputy Admin. |
| Rev | Date | Description | Prepared By | Reviewed By | Approved BY |
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**1. SCOPE**

This specification covers 23kV ACSR/AW-TR/OC to be used tracking resistant insulation wire for the distribution of electrical energy under the normal conditions of overhead line service.

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| --- | --- |
| Cable description | Cable type |
| Aluminum-Clad Steel-Reinforced Conductor and Semiconductor, XLPE Insulation, and Sheath for Working Voltage 13.2kV to 23kV | 13.2kV to 23kV ACST/AW-TR/OC |

1. **REFERENCE STANDARDS**

**2-1. PEC Chapter 3**:Wiring Methods and Materials

**2.2. IEC 60811**: Common test methods for insulating and sheathing materials of electric cables and optical cables

**2.3. IEC 60587(2007)**: Electrical insulating materials used under severe ambient conditions – Test methods for evaluating resistance to tracking and erosion

**2.4 ASTM G 154 (2006)**: Operating Fluorescent Light Apparatus fo UV Exposure of Nonmetallic Materials

**2-5. ES-6145-0021**: Technical Standard of ACSR/AW-TR/OC for 23kV

1. **TYPE AND STANDARD**

The type and standard of wire shall be in accordance with Table 1

**<Table 1.>**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Cross- sectional area  (㎟) | Conductor | | | Nominal Conductor  Screen Thick.  (mm) | Nominal Insulation Thick.  (mm) | Nominal Covering Thick.  (mm) | Overall Dia. (Approx.)  (mm) |
| Construction | | Outside  Diameter  (mm) |
| Al  (mm) | St  (mm) |
| 58 | 6/SB\* | 1/3.5 | 9.7 | 0.6 | 1.2 | 1.2 | 15.7 |
| 95 | 6/SB | 1/3.5 | 12.0 | 0.6 | 1.4 | 1.5 | 19.0 |
| 160 | 18/SB | 1/3.2 | 15.4 | 0.6 | 1.7 | 1.7 | 23.4 |
| 240 | 18/SB | 1/4.0 | 18.9 | 0.6 | 1.7 | 1.7 | 27.0 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Cross- sectional area  (㎟) | Max. Conductor Resistance  at 20℃  (Ω/km) | A.C. Break- down Voltage  (kV) | A.C. Test Voltage  (kV) | Breaking  Load  KN  (kgf) | Weight (Approx.)  (Kg/km) | Min. Insulation Resistance  at 20℃  (MΩ/km) | Standard  Length  (m/reel) |
| 58 | 0.484 | 60 | 25 | 18.62  (1,900) | 360 | 1,500 | 600,1000\*\* |
| 95 | 0.302 | 60 | 25 | 23.13  (2,360) | 560 | 1,500 | 600,1000 |
| 160 | 0.183 | 72 | 25 | 30.18  (3,080) | 750 | 1,500 | 600.1000 |
| 240 | 0.123 | 72 | 25 | 44.10  (4,500) | 1,040 | 1,500 | 600,1000 |

\*SB (Smooth body): concentric compacted stranded form

\*\* 1000m/reel is for a big project

1. **CONSTRUCTION AND MATERIAL**

**4.1 Conductor**

4.1.1 Hard-drawn aluminum wires

The conductor shall be compacted stranded conductor of hard drawn aluminum wire in combination with aluminum-clad steel wire. The construction of the conductor shall be in accordance with Table 1 and 2.

The interstices of the stranded conductor shall be sealed with a suitable material, as a rule, using swelling tapes as an impediment to longitudinal water penetration.

4,1,2 Conductor screen

The conductor screen shall consist of an extruded semi-conducting compound and firmly bonded to the insulation. The nominal thickness of conductor screen shall be in accordance with table 1.

4.1.3 Aluminum-clad steel wire

Aluminum-clad steel wire shall be close adhesion covering to aluminum. Characteristic should be the same as in Table 2 before stranded

**<Table 2.>**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Size  (Dia.)  (mm) | Diameter  Tolerance  (mm) | Tensile  strength  Min.  KN/㎟  (Kg/㎟) | Elonga- tion  Min.  (%) | Conduc- tivity  Min.  (%) | Twist to Break  (No.) | Characteristic of Aluminum | | Reference value | | | |
| Al Min. Thick.  (mm) | Rolling  Test | Al  Nom. Thick.  (mm) | Breaking load  KN (Kgf) | Electric Resistance  Ω/km | Approx.  Weight  (kg/km) |
| **3.2** | **. ±0.06** | **1,27**  **(130)** | **1.5** | **. 20.3** | **16** | **0.15** | **Do  not**  **crack** | **0.22** | **10.29 (1,050)** | **. 10.6** | **53** |
| **3.5** | **±0.07** | **1,27**  **(130)** | **1.5** | **20.3** | **16** | **0.15** | **0.24** | **12.25 (1,250)** | **8.83** | **63.4** |
| **4.0** | **±0.08** | **1,23**  **(125)** | **1.5** | **20.3** | **16** | **0.20** | **0.27** | **15.39 (1,570)** | **6.76** | **82.8** |

4.1.3 Lay

The direction of lay of aluminum and steel wires shall be reversed in successive layers. The outermost layer of wires in all conductors shall be in left-hand direction of lay(S). A multiple of pitch is not more than the values in Table 3.

External diameter is ±2% the values in Attached Table, and cross-sectional area is not less than 95% of Nominal-sectional area.

**<Table 3.>**

|  |  |  |  |
| --- | --- | --- | --- |
| Number of wire | | Pitch of Aluminum | |
| AL | SW | Outside of Layer | Inside of Layer |
| 6 | 1 | 16 | - |
| 18 | 1 | 14 | 17.5 |

4.1.4 Joints of Wire

There shall be no joints of Aluminum-clad steel wire

**4.2 Insulation**

The XLPE shall be concentrically applied on the conductor. The average thickness of the insulation shall be not less than 90% of the nominal value given in the attached table. The minimum thickness of the insulation shall be not less than 80% of the nominal value given in the Table 1.

The surface of insulation may have protrusion.

1. **CHARACTERISTICS AND TEST METHOD**

Characteristics and tests method shall be in accordance with Table 4

**<Table 4>**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test item | | | Criteria | | Category of Test |
| Aluminum-clad steel wire tests | Appearance | | No damage | | Routine |
| Material | | Comply with Table 2 | | Sample |
| Tensile strength | | Comply with Table 2 | | Type |
| Electric conductivity | | Comply with Table 2 | | Type |
| Torsion test | | Comply with Table 2 | | Type |
| Wrapping test | | No crack | | Type |
| Bending test | | No crack | | Type |
| Compression test | | No separation | | Type |
| Stranded conductor & insulation tests | Appearance | | No damage | | Routine |
| Construction | | Comply with Table 1 | | Sample |
| High voltage | | No breakdown  (25kV/1min.) | | Routine |
| Conductor resistance | | Comply with Table1 | | Type |
| Conductor breaking load | | | Comply with Table1 | Type |
| Insulation & Covering (120t/120h) | Before aging | | Tensile strength : 9.8N/㎟ ' Elongation : 350% ' | Type |
| After aging\* | | Tensile strength : 80% ' Elongation : 80% ' |
| Heat shock | | | No crack at 120±3t | Type |
| Cold bend | | | No crack at -30±13t | Type |
| Pressure test at high temperature | | | 40% | Type |
| Insulation resistance | | | Comply with Table1 | Type |
| Tracking test | | | 60mA /2sec or  no combustion | Type |
| Water penetration of conductor | | | No leakage at 0.5atm,24h | Sample |
| Dropping test | | | No drop at 100±3t,24h | Routine |
| Adherence test | | | Skidding distance 5mm | Type |
| Conductor screen  volume resistivity | | | 1000Q-m | Type |
| Weather resistance (1000h) | | | Tensile strength : 80% ' Elongation :: 70% ' | Type |
| AC breakdown voltage (Min.) | | | Comply with Table1 | Type |
| \* The percentage value shall be applicable to the value obtained before aging.  ※ The type test above can be omitted by consultation between purchaser and manufacturer. | | | | | |

1. **INSPECTION**

Inspection shall be made in accordance with Table 1, 2. 3.

1. **PACKING**

The cable shall be wound on reel with wooden drum (or Plastic drum) such as to prevent damage during transportation. The batten shall be tightly fixed to the drum. Following description shall be marked on a flange of the reel.

* Direction of rotation of the reel
* Position of the winding finish end of cable
* Type of the cable
* Number of conductors and size
* Cable length
* Net and Gross weight
* Manufacturer’s name
* Year of manufacture
* Reel No.(if required)

1. **MARKING**

**8.1 Cable marking**

The following information shall be repeatedly indenting on the surface of the cable at regular intervals over the entire length.

* + - Voltage (23kV)
    - Type (ACST/AW-TR/OC)
* Cross Sectional Area (e.g. : 160SQMM)
* Manufacturer's name (\*\*\*\*\*\*\*\*\*\*)
* Year of manufacture (e.g. : 2016)
* Quality Guaranty Mark (e.g. : [PC, ICC, UL or KEWIC])

e.g. : 23kV ACSR/AW-OC 160SQMM \*\*\*\*\*\*\*\*\*\* 2016 [PC, ICC, UL or KEWIC]

**8.2 LENGTH MARKING**

The serial length marking shall be printed or indented on the surface of outer sheath per 1 meter interval throughout the length of cable. If the cable diameter is less than 8mm, the length marking may be omitted.

CROSS-SECTIONAL DRAWING and PHOTO

|  |  |
| --- | --- |
|  | Aluminum-clad steel wire  Hard-drawn aluminum wires  Semiconductor  Cross-linked polyethylene  Insulation (XLPE)  Sheath |
|  | From Right;  ACSR/AW-TR/OC 58MM  ACSR/AW-TR/OC 95MM  ACSR/AW-TR/OC 160MM  ACSR/AW-TR/OC 240MM   * **This Smooth Body Type will bring the reduction of wire loss and wind loading** |