



Eskom

Standard

Technology

Title: **HIGH FREQUENCY COAXIAL
CABLE FOR POWER LINE
CARRIER APPLICATIONS**

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Tables

Table 17

1. Introduction

This standard is necessary for specifying Eskom's technical requirements for the procurement of high frequency (HF) coaxial cables.

2. Supporting clauses

2.1 Scope

This standard applies to HF coaxial cables for power line carrier applications.

2.1.1 Purpose

This standard provides for the manufacture, testing at works, user documentation, supply and delivery to Eskom's stores and off-loading.

2.1.2 Applicability

This specification is applicable to all Eskom's power line carrier applications.

This document shall apply throughout Eskom Holdings Limited Divisions.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

- [1] ISO 9001, Quality Management Systems.
- [2] SANS 1091, National colour standard.
- [3] SANS 1507-6, Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) Part 6: Service cables
- [4] SANS 1411-1, Materials of insulated electric cables and flexible cords Part 1: Conductors
- [5] SANS 1411-2, Materials of insulated electric cables and flexible cords Part 2: Polyvinyl chloride (PVC)
- [6] SANS 1411-6, Materials of insulated electric cables and flexible cords Part 6: Armour.
- [7] SANS 1411-7, Materials of insulated electric cables and flexible cords Part 7: Polyethylene (PE).
- [8] SANS 6282-3, Test methods for bare conductors and conductors of insulated electric cables Part 3: Mechanical tests.
- [9] SANS 62230 Electric cables - Spark-test method
- [10] SANS 6284-3 Tests on finished cable.

2.2.2 Informative

None

2.3 Definitions

2.3.1 General

| Definition | Description |
|-----------------|---|
| Technical Terms | For the purpose of this specification, technical terms used shall be as defined in the documents listed in clause 2.2.1 Normative References. |

2.3.2 Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 Abbreviations

| Abbreviation | Description |
|--------------|--------------------|
| HF | High Frequency |
| PE | Polyethylene |
| PVC | Polyvinyl Chloride |

2.5 Roles and responsibilities

Not applicable.

2.6 Process for monitoring

This standard shall be updated periodically according to Eskom's policy and the latest version shall be available for use at all times.

2.7 Related/ supporting documents

Not applicable.

3. Requirements

3.1 General

The general requirements for the specified cable are enlisted in the A / B schedules. The basic requirements for the coaxial cable specified in this document are as follows:

- a) Nominal impedance 75 ohms
- b) Maximum diameter of sheath over outer (braided) conductor 11mm
- c) Minimum bending radius of cable without outer armouring 100mm

3.2 Armoured Coaxial Cable Technical Details

The Tenderer shall state the national or international specification with which their cable complies.

3.3 Electrical Performance

Eskom requirements for the electrical performance of the coaxial cable are listed in the A/B schedules of this document. The cable shall have the following attenuation capability:

- a) At 500kHz 0.004dB / meter
- b) At 2MHz 0.11dB / meter

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3.4 Conductor

The conductor of the coaxial cable shall consist of 7 strands each of 0.4mm diameter tinned annealed copper wire complying with the requirements of SANS 1411-1, class 2. Details of the technical requirements are listed in Schedules A of this specification.

3.5 Insulation

The conductor shall be insulated with a solid dielectric of extruded polyethylene with a nominal diameter of 7.2mm. The polyethylene shall be compliant with SANS 1411-7, type PD1.

3.6 Copper braid

A single braid shall be applied comprising plain annealed copper wires. The nominal diameter of each wire shall be 0.2mm.

3.7 Inner Sheath / Bedding Layer

The cables shall have black, general-purpose PVC bedding compliant with SANS 1411-2. Fillers may be applied integrally with either the bedding or the inner sheath according to SANS 1507-4 (where applicable). Filler materials shall be acceptable for the specific type of cable.

3.8 Armouring

The overall armouring of the cable must consist of 0.9mm diameter galvanised steel strands in accordance with the requirements of SANS 1411-6. Tape armouring is not acceptable.

3.9 Outer sheath

The outer conductor shall be enclosed in a black, flame retardant PVC sheath complying with SANS 1411-2. Furthermore, the outer sheath shall be UV (Ultra Violet) resistant and the supplier shall quote the relevant SANS/ IEC standard.

3.10 Coaxial Cable Samples

A sample length of a minimum of 1 metre of the cable covered in this specification shall be submitted, upon Eskom's request.

3.11 Sealing

All cable ends are to be sealed on completion of all tests, prior to delivery.

3.12 Coaxial Cable Drums

The coaxial cable shall be supplied in non-returnable, strong, new wooden drums, impregnated to provide protection against moisture. The inside faces of the flanges and the barrel of each drum shall be smooth and free of splinters in order to prevent sharp edges or wood splinters or any other irregularity causing damage to the PVC cable during rolling onto or unrolling the drum. These interior surfaces of the drum shall also be lined with a strong paper covering.

After being rolled onto the drum, the cable shall be covered by a thick canvas or hessian wrapper. Alternatively, the cable may be covered by 3mm thick compressed tempered hardboard, strapped around the cable by at least two steel straps. The cardboard shall be a neat fit between the flanges of the drum. After the cable has been covered, the drum shall be lagged by battens of adequate thickness to prevent damage to cable during storage and transit. The battens shall be butted and shall enclose the cable space completely.

3.13 Environmental Conditions

The performance of the specified coaxial cable shall not be degraded when operated under the following environmental conditions:

- Outdoors
- Underground
- The maximum and minimum operating temperatures according to SANS 1411-2

3.14 Quality Assurance

Eskom's Quality Assurance requirements are specified by Eskom's Quality department.

4. Tests

4.1 Test Methods

The cable supplied in this specification must be tested at the works, as detailed in the SANS 1507-6 as a minimum requirement. Eskom will, however, accept standard European or American test methods on imported cable if evidence provided indicates that these are equal to, or more stringent, than the test specified.

In view of the above requirements, all details of the manufacturer's intended "Type", "Sample" and "Routine" tests are to be supplied with the tender document.

4.2 Type Tests

All type tests must be performed in accordance with Table 1.

Table 1

| No. | Component | Test Property | Reference |
|-----|----------------|---------------------|--|
| 1 | Conductor | Elongation at Break | According to SANS 6282-3, Section 2. Elongation at break of wire |
| 2 | Insulation | Physical properties | According to SANS 1411-7 Polyethylene (PE) |
| 3 | Insulation | Spark test | According to SANS 62230 |
| 4 | Sheath | Physical properties | According to SANS 1411-2 Polyvinyl chloride (PVC) |
| 5 | Finished Cable | Voltage withstand | According to SANS 6284-3 |

4.3 Test certificates

Records of all test results must be available for inspection by Eskom's representative at any time during the validity of the contract period.

The coaxial cable shall be subject to the manufacturer's standard works tests, details of which must be supplied with the tender.

4.4 Witnessing of Tests

Eskom reserves the right to appoint a representative to inspect the cable at any stage of manufacture or to be present at any time that tests are performed. If witnessed type tests apply, the samples must be selected according to the procedure detailed in SANS 1507-6. Such inspection shall not relieve the manufacturer of his responsibility for meeting the requirements of the specification, and it shall not prevent the subsequent rejection if the goods are later found to be defective.

Eskom must be informed of inspection or witnessed tests, and Eskom requires not less than 7 days prior notice of such tests.

5. Packaging and Delivery

5.1 Packaging

Cables shall be supplied in drum lengths indicated by Eskom and would be dependent on each project requirement. All cables shall be marked with the following:

- Eskom order number.
- Eskom cable code and specification to which the cable is manufactured.
- Gross mass of drum and cable in kilograms.
- The words "Not to be laid flat" shall be written visibly on the drum.
- The name of the Manufacturer and Trade mark
- Arrow indicating the correct direction of rolling
- The length of the cable

The coaxial cable supplied in each drum shall be in one continuous length and shall have no joints in the centre or inner conductor.

5.2 Delivery

- a) The equipment shall be delivered to the destination stated in the enquiry document
- b) The ex-work delivery dates, and delivery dates to site shall be indicated in the relevant schedule of the enquiry document.
- c) The equipment shall be protectively packed in such a way that it can be safely transported, handled and stored at site, as it will not necessarily be possible for installation to commence immediately upon delivery.
- d) Attention is drawn to the fact that Eskom will accept delivery at the specified destination only, and that the supplier shall make all necessary arrangements for acceptance, off-loading and trans-shipment at all intermediate points, as well as the ultimate off-loading at the specified destination.

5.3 Documentation

The supplier shall furnish Eskom with the following product documentation:

- a) Cable specification
- b) Cable construction details

5.4 Statement of Compliance or Deviation

The Tenderer must complete Schedule B of Annex A - Schedules A and B by stating compliance with or deviation from the requirements of this specification and Schedule A. Any deviations from this specification or Schedule A shall be listed in Annex B - Statement of Non-Compliance, on a section by section and clause by clause basis.

6. Authorization

This document has been seen and accepted by:

| Name and surname | Designation |
|--------------------|--|
| Lenah Mothata | Senior Manager – Grids |
| Barry Clayton | Chief Engineer – Secondary Plant , Works Planning and Centralized Services |
| Sikelela Mkhabela | Senior Manager – DX |
| Prudence Madiba | Senior Manager – GX |
| Joe Manyisa | Senior Manager – Eskom Telecommunications (Acting) |
| Oliva Muwanga-Zake | Senior Manager – GIT |
| Lloyd Chego | Senior Manager – Group Security |

7. Revisions

| Date | Rev | Compiler | Remarks |
|----------|-----|-----------|--|
| Feb 2019 | 2 | R. Gangat | Included the following Type Test requirements according to SANS 1507-6, SANS 6282-3 Mechanical tests, SANS 62230 Electric cables - Spark-test method, SANS 1411-2 Polyvinyl chloride (PVC), SANS 1411-7 Polyethylene (PE) and SANS 6284-3 Tests on finished cable. |
| Aug 2013 | 1 | T. Gosai | First issue. |

8. Development team

The following people were involved in the development of this document:

- R. Gangat
- T. Gosai
- A. Pereira (Tony)

9. Acknowledgements

Not applicable.

Annex A – Schedules A and B

| ITEM | DESCRIPTION | SCHEDULE A | SCHEDULE B | REMARKS |
|------|--|---|------------|---------|
| 1 | Manufacturer | | | |
| 2 | National, International or Military Specification with which the cable complies | Specify | | |
| 3 | Cable equivalent to RG12 A/U with Overall PVC Sheath | YES | | |
| 4 | Electrical specification a) Continuous voltage rating b) Capacitance c) Attenuation 1) At 500kHz 2) At 2MHz d) Frequency range e) Corona extinction voltage Vrms(min) f) Characteristic impedance g) Spark tests voltage Vrms(min) | Specify 67pF / meter (5% Tolerance) 0.004dB / meter 0.11dB / meter 40 - 500kHz Specify 75Ω Specify | | |
| 5 | Inner conductor (core) details a) Number b) Conductor area mm ² c) Conductor material d) Number of Cu strands e) Strand diameter f) DC resistance at 20°C ohms/km g) 50Hz resistance at 20°C ohms/km | 1 0.9 Sn annealed Cu 7 0.4mm < 20 Specify | | |

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| ITEM | DESCRIPTION | SCHEDULE A | SCHEDULE B | REMARKS |
|------|---|---|------------|---------|
| | h) Inductive reactance at 50Hz ohms/km i) Capacitance: 1) pair to the sheath $\mu\text{F}/\text{km}$ 2) between cores of a pair $\mu\text{F}/\text{km}$ j) Maximum continuous conductor temperature $^{\circ}\text{C}$ | Specify Not applicable Not applicable Specify | | |
| 6 | Dielectric Material a) Material composition b) Dielectric constant c) Specify gravity d) Velocity of propagation e) Temperature limits f) Overall diameter | Polyethylene 2.3 Specify Specify Specify 7.2mm | | |
| 7 | Insulation material a) core insulation compound used b) screen insulation compound used c) cable sheath compound used d) fire propagation properties of finished cable e) smoke/acid gas emission for 1) core insulation 2) bedding and screen insulation 3) finished cable f) Power frequency withstand test voltage for one minute (centre conductor to outer conductor) | Specify Specify Specify Specify Specify Specify Specify 4kVrms | | |

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| ITEM | DESCRIPTION | SCHEDULE A | SCHEDULE B | REMARKS |
|------|---|---|------------|---------|
| 8 | Outer Braid Conductor / Screen and Armouring a) screen material b) screen filling factor c) screen thickness d) water barrier e) braided screen f) individual screen thickness mm g) individual screen resistance ohms/km h) individual screen coverage 100% i) overall screen resistance ohms/km j) armouring wire material k) armouring wire diameter mm l) armouring tensile strength N/mm | Plain annealed copper wires Specify 0.2mm wires Specify YES Specify Specify YES Specify Galvanised steel 0.9 Specify | | |
| 9 | Complete cable a) Diameter mm b) Min. bending radius mm c) Mass kg/km d) Drum length 1) average m 2) minimum m 3) maximum m e) Drum markings (Clause 4.1) | 16 100 Specify Specify Specify YES | | |

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| ITEM | DESCRIPTION | SCHEDULE A | SCHEDULE B | REMARKS |
|------|---|--|------------|---------|
| 10 | <p>a) Tests conducted according to SANS 1507-6 prior to contract award.</p> <p>1) Conductor elongation at break according to SANS 6282-3.</p> <p>2) Insulation physical properties according to SANS 1411-7</p> <p>3) Insulation spark test according to SANS 62230</p> <p>4) Sheath physical properties according to SANS 1411-2</p> <p>5) Finished cable voltage withstand according to SANS 6284-3</p> <p>b) State the location within the tender documentation where the Type Test Certificates for the following tests can be found:</p> <p>1) Conductor elongation at break according to SANS 6282-3.</p> <p>2) ii Insulation physical properties according to SANS 1411-7</p> <p>3) iii Insulation spark test according to SANS 62230</p> <p>4) iv Sheath physical properties according to SANS 1411-2</p> <p>5) Finished cable voltage withstand according to SANS 6284-3</p> <p>c) Samples supplied (minimum of 1 metre)</p> | <p>YES/NO</p> <p>YES/NO</p> <p>YES/NO</p> <p>YES/NO</p> <p>YES/NO</p> <p>Specify</p> <p>Specify</p> <p>Specify</p> <p>Specify</p> <p>Specify</p> <p>YES/NO</p> | | |

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