Eskom	Standard	Technology

Title: **THE STANDARD FOR CONCENTRIC SERVICE CABLE WITH COMMUNICATION CORES, TINNED COPPER AND COATED STEEL**

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Date: 30 March 2017

PCM Reference: **<xxxxxx>**

SCOT Study Committee Number/Name: **<Number or name>**

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1. Introduction

This specification covers requirements for the tinned copper and coated steel concentric type of service cable to connect customers to the low voltage reticulation system and to enable the purchaser to acquire the cable without the need for detailed and extensive contract documents.

The “more safe” cable (6mm²) shall meet SANS 1507-6 requirements and “additional” requirements as per the Eskom specification.

The preceding specification is DSP 34-2023 concentric cable with communication cores for split metering.

The design shall address issues of contact between wires and fusing of individual strands.

Mechanical strength of the cable is addressed by steel galvanised steel wires as gap fillers.

Tinning of copper is required to ensure corrosion compatibility and improve the electrical contact resistance between steel and copper.

Tinning and mixed metals might reduce theft by:

- Mimicking an Al cable
- Contaminate metallurgical meltdown of stolen cable

2. Supporting clauses

2.1 Scope

This specification specifies Eskom’s requirements for the manufacture and supply of 6mm² (more safe) concentric service cable for nominal system a.c. voltages up to and including 0.6/1kV. It is intended for use in overhead, single-phase connections to a customer’s installation, but it may also be installed underground. There are two communication cores included in the design.

2.1.1 Purpose

This document is intended for use in overhead, single-phase connections to a customer’s installation, but it may also be installed underground.

2.1.2 Applicability

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

For the purpose of this specification, the references given in SANS 1507-6 will apply.

[1] ISO 9001, Quality Management Systems.

[2] SANS 1507-1, Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V) Part 1: General

[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 1411-4, Materials of insulated electric cables and flexible cords Part 4: Cross-linked polyethylene (XLPE)

[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)

2.2.2 Informative

The following document, in addition to those listed in the specification, was a source of reference in compiling this specification. It does not constitute provisions of this specification but is referenced for further information.

[8] IEC 50:1984,International Electrotechnical Vocabulary (IEV) Chapter 461: Electric cables.

2.3 Definitions

2.3.1 General

For the purpose of this specification, the definitions (for terms not given below) and abbreviations given in SANS 1507-1 shall apply.

NOTE: The terms used in this specification are generally consistent with the definitions given in the International Electrotechnical vocabulary (IEV)

Definition	Description
Binder	A layer incorporated in a cable with the specific functions of holding the components within the layer together.
Breaking load	The tensile load applied during testing, when the cable finally breaks or becomes permanently deformed
Compacted conductor	A stranded conductor in which the interstices between the component wires have been reduced by mechanical compression or by drawing
Concentric cable	A cable consisting of a central phase core surrounded by a concentrically applied layer of strands, comprising the neutral/earth conductor
Conductor	A part of a cable which has the specific function of carrying current
Current rating	The rated normal current of a cable is the r.m.s. value of current that the cable can carry continuously under the specified conditions of use and behaviour
Insulation	Insulating materials incorporated in a cable with the specific function of withstanding voltage
Stranded conductor	A conductor consisting of a number of individual wires, all or some of which generally have a helical form
UV stabilized	Modified by methods to withstand ultraviolet radiation

2.3.2 Disclosure classification

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

2.4 Abbreviations

Abbreviation	Description
GSW	Galvanised steel wire
AL	Aluminium
N/E	Neutral/Earth
TCU	Tin coated copper wire

Abbreviation	Description
XLPE	Cross-linked polyethylene
PE	Polyethylene

2.5 Roles and responsibilities

The relevant sections within Eskom Distribution are responsible to implement the new design according to the requirements as listed in this document.

2.6 Process for monitoring

Adherence to this document shall be monitored through routine inspections.

2.7 Related/supporting documents

Not applicable.

3. Requirements

3.1 General

'The cable shall comply with this specification and SANS 1507-6 and “additional” Eskom requirements.

a) The GSW strands shall comply with this specification and SANS 1411-6.

b) The TCU strands shall comply with this specification and SANS 1411-1

3.2 Construction Requirements

3.2.1 Conductor

a) The central conductor of the cable referred as the phase or live conductor see figure 1 for a typical construction shall consist of 6 circular tin coated hard drawn copper strands and 1 galvanised steel wire.

b) The phase and neutral conductor nominal copper equivalent cross-sectional (including the GSW) area shall be 6 mm² in each case. Compliance is determined by the maximum DC resistance as per clause 3.5.a.

c) The central insulated core shall be surrounded by:

- an arrangement of alternating GSW and annealed TCU wires and
- one blue and one white PE insulated stranded copper communication cores placed next to each other and shall comply with SANS 1507.

d) Neutral/earth strands or GSW and TCU wires shall be in electrical contact over the length of the cable and that compliance is determined by continuity testing between two bare N/E wires on either side of the two communication cores over a specified length (typically 3m) of cable.

3.2.2 Insulation and Outer Sheath

a) The core insulation of the conductor shall be colour fast red UV stabilized XLPE type B that complies with the requirements of SANS 1411-4. Compliance to UV stability requirements is verified by testing to UL 1581. Colour fastness compliance is verified by positive visual identification of the red colour following the UV stability test.

b) The concentric assembly shall be enclosed in a black sheath of a weather stabilized grade polyethylene that complies with materials PS1 (sheathing grade) in accordance with SANS 1411 - 7. A black sheath shall have a single line ridge for identification purposes.

c) A ripcord laid under the sheath shall be provided for stripping of the cable.

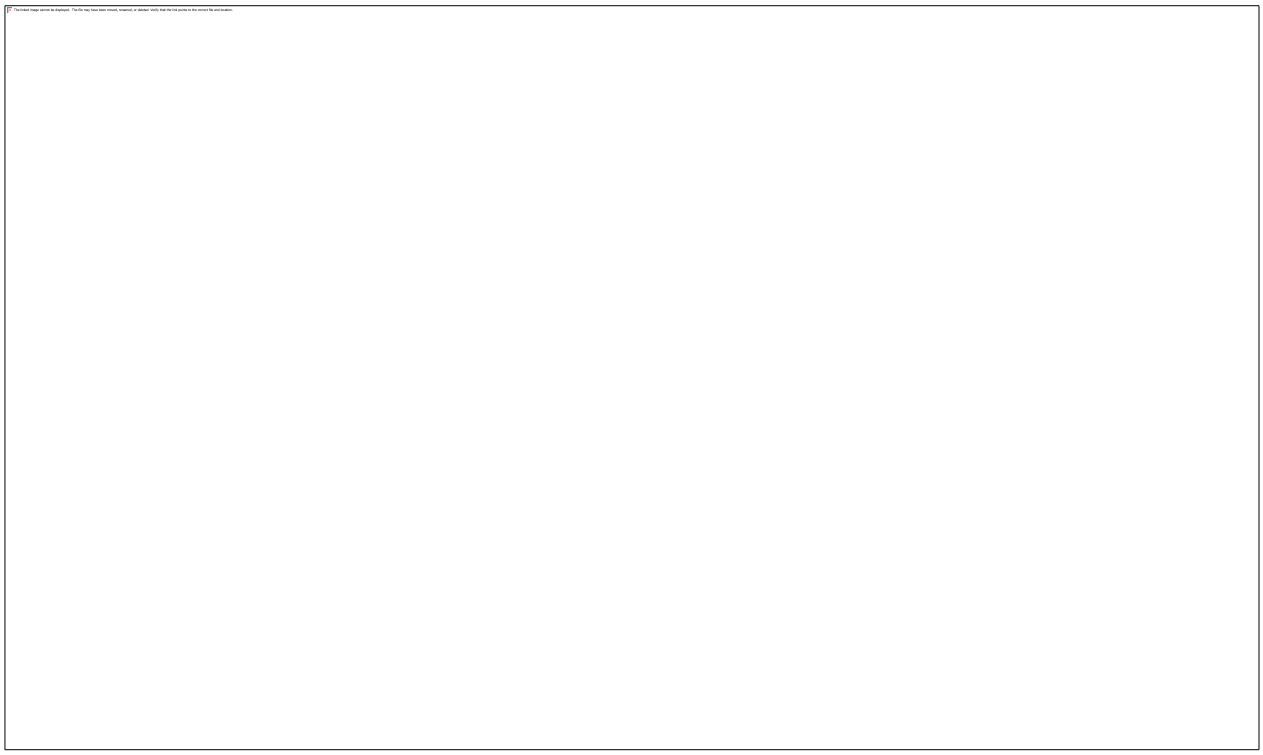

Figure 1: Typical construction: Concentric service cable with communication cores and GSW. Nominal diameters are shown in the diagram.

3.3 Dimensions

The cable shall comply with the following overall diameters:

- Minimum – 11.7mm
- Maximum – 11.28mm

3.4 Mechanical requirements

a) When a cable is tested in accordance with 4.1.2, there shall be no signs of distortion or cracking of the insulation or sheath.

b) When a cable is tested in accordance with 4.3.1 the slippage of the outer sheath with respect to the commercial clamps specified shall comply with the following requirements:

slippage after 15 minutes at 0,7 kN	$S_1 \leq$ 2mm
slippage after 1 hour at 1,0 kN	$S_2 \leq S_1$ + 3mm

3.5 Electrical requirements

a) When tested in accordance with SANS 1411-1 the DC resistance of the phase and neutral conductors (including the GSW) at 20 ºC shall not exceed 3,21 Ω/km and 3,11 Ω/km respectively.

b) The continuous current rating in air (in direct sunlight) at 30°C shall be not less than 60A when the phase conductor is at 90 °C.

c) The continuous current rating of the cable when installed in air at 30°C and when installed, underground at 25°C shall be stated in Schedule B.

4. Tests

4.1 Type tests

4.1.1 General

For the purpose of this specification the type tests of the cable given in SANS 1507-6 shall apply.

The type tests shall be performed a recognized test authority approved by the purchaser. If a previous report on an identical cable has been produced, a copy of this report may be submitted.

If any changes in the cable design are made, such as change of conductor type, change of insulation thickness, change of conductor diameter or change of insulation material, then the type test shall be repeated.

4.1.2 Bending radius

Carefully bend the sample around a mandrel of diameter equal to eight times the diameter of the cable to make a 180° turn and check for compliance with 3.4a.

4.2 Routine tests

The Routine tests shall be performed on each completed cable drum and complied with SANS 1507-6.

4.3 Sample tests

The Sample tests shall comply with SANS 1507-6 and SANS 1411-6

NOTE: It is intended that the sample tests be conducted at the manufacturer's works on a regular basis.

4.3.1 Adherence of cable sheath to concentric layer test

Conduct the tests at an ambient temperature between 10°C and 30°C and at a humidity of less than 80%.

4.3.1.1 Test procedure

- Mount a reference clamp and a commercially available clamp on opposite ends of a section of service cable of length about 4m, at least 2m apart.
- Apply a steady increasing load (in Newton) up to a value of 0,7kN onto the cable and allow it to settle for a period of 5 minutes.
- Mark the cable at the inner end of the commercial clamp so that any slippage of the cable sheath over the concentric layer is measurable.
- Maintain the tension on the cable at a constant load of 0,7kN for 15 minutes.
- Mark the cable at the inner end of the commercial clamp and record the slippage.
- Increase the load steadily to 1,0kN.

- Maintain the tension on the cable at a constant 1,0kN load for 1 hour.
- After the 1 hour has elapsed, mark and record the slippage from the 0,7kN point.

5. Marking, labeling and packaging

a) The requirements of section 5 of SANS 1507 shall apply.

b) If so specified in Schedule A, the outer sheath of the cable shall be sequentially marked at 1 m intervals. Lengths of cable may be wound on drums, commencing at any sequential mark. The "start" and "finish" lengths of sequential marking shall be shown on the drum label in those instances where the start is not zero.

c) The marking shall include specification number to which the cable has been manufactured, the word “ESKOM” and cable size. A typical legend would be:

“XXXXXXXX CABLES YEAR 600/1000V 6mm2 SANS 1507 ESKOM”

d) The method of indication shall be an embossed mark or colour coded thread.

e) Unless otherwise specified in Schedule A the standard length of supply shall be:

cable size (mm^2)	supply length (m)
6	500

6. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Bheki Ntshangase	HV Plant Senior Manager
Riaz Asmal	MV/LV Study Committee Chairman

7. Revisions

Date	Rev	Compiler	Remarks
April 2017	2	J Maudu	4.2.1.3 an equal number of GSW and TCU strands changed to an arrangement of alternating GSW and TCU wires two insulated copper communication cores changed to one blue and one white insulated copper communication cores placed next to each other. 4.2.1.4 The neutral/earth strands shall be in a single layer and in continuous physical contact with each other at all times changed to neutral/earth strands or GSW and TCU wires shall be in electrical contact over the length of the cable and that this is determined by continuity testing between two bare N/E wires on either side of the two communication cores over a specified length of cable. 4.2.2.2 PD1 (insulation grade) changed to PS1 (sheathing grade) 6mm² concentric cable replaces 8mm² (this is to be in line with IEC concentric cable standard sizes) 3.3 Dimensions The cable shall comply with the following overall diameters: • Minimum – 11.7mm • Maximum – 12.8mm 3.5 Electrical requirements a) When tested in accordance with SANS 1411-1 the DC resistance of the phase and neutral conductors (including the GSW) at 20 ºC shall not exceed 3,21 Ω/km and 3,11 Ω/km respectively.
Aug 2013	1	J Maudu	First issue

8. Development team

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

- Jutas Maudu
- Hendri Geldenhuys
- Dayalin Padayachy

9. Acknowledgements

Not applicable.

Annex A – Miscellaneous information for purchasers

(Informative)

A.1 Schedules A and B

The schedules A and B in annex B are included in this document for information only: they are intended to be guides to purchasers, in the areas of format and Eskom's specific technical requirements, to help them to prepare schedules which are applicable to a particular enquiry or tender.

A.2 Commercial conditions

A purchaser will need to indicate the commercial conditions applicable and draw up a price schedule. Requirements for delivery, storage, packing and marking should be attended to in this part of the enquiry.

A.3 Quality assurance

The specification requires the manufacturer to comply with either:

- Eskom EVS 005
- SABS ISO 9000 listing
- An Eskom approved Quality Assurance system

A.4 Testing

Attention should be paid to the subject of tests and the related costs. Type and routine tests should be carried out by an Eskom approved party and tenderers should be requested to provide assurances on this point. Price schedules should be so drawn up and covering letters so worded that the costs of all services such as tests, delivery and spares are declared and allowed for in the tender.

A.5 Revisions of standards used as normative references

This specification, as has been indicated, is based on a set of defined standards which may have been revised or amended. It may be expected that most purchasers would in principle wish to employ the latest standards. It is recommended that an approach to this question be to secure an undertaking from a supplier to review the latest versions and amendments and incorporate these where possible and agreeable to both parties. A blanket commitment to work to the "latest" versions of standards creates risks for both parties and should be properly assessed. This invariably cannot be done in the time available.

Annex B – Model Form for Schedules A and B

Schedule A: Eskom's specific requirements

Schedule B: Guarantees and technical particulars of equipment.

1	2	3	4	5
Item	**Sub clause of this document**	**Description**	**Schedule A**	**Schedule B**
1		Quantity of cable required		
2		Approximate length per drum	xxxx	
3		Approximate mass per drum	xxxx	
4	3.2.1	Phase core		
		- Material	xxxx	
		- size; mm²	6	
		- no of Copper strands/ tinned hard drawn	6	
		- no of GSW	1	
		- size of Copper strands; mm²	xxxx	
		- size of GSW strands; mm²	xxxx	
		Insulation material	XLPE	
	3.2.1	Insulation thickness mm	xxxx	
		Communication cores (stranded)	xxxx	
		Tolerance ± mm	xxxx	
	3.5	Resistance at 20°C Ω	xxxx	
5	3.2.1	Neutral earth conductor		
		Size of tinned anneal copper strands; mm²	xxxx	
		Size of GSW strands; mm²	xxxx	
		Material	xxxx	
		Number of Copper stands	xxxx	
		Number of GSW strands	xxxx	
6	3.3	Thickness of outer sheath mm	xxxx	
7	3.3	Overall diameter of cable mm	xxxx	
		Tolerance ± mm	xxxx	
8		Nominal mass of cable kg/km	xxxx	
9	3.4	Minimum bending radius of cable mm	xxxx	

1	2	3	4	5
Item	**Sub clause of this document**	**Description**	**Schedule A**	**Schedule B**
10	3.5	Continuous current rating at 90°C		
		- in air (in direct sunlight) at 30°C A	xxxx	
		- underground at 25°C A	xxxx	
11	3.5	Dielectric resistance at 20°C MΩ.km	xxxx	
12		Sequential marking on cable and length marking shown on drum label	Yes / No	
	4	Did the cable pass the adherence of sheath to concentric layer test	xxxx	
13	5	Method of indication on cable	xxxx	
14		Does the cable comply fully with this specification, If not, state exceptions	xxxx	

Annex C – Impact assessment

(Normative)

Impact assessment form to be completed for all documents.

1) Guidelines

All comments must be completed.

- Motivate why items are N/A (not applicable)
- Indicate actions to be taken, persons or organisations responsible for actions and deadline for action.
- Change control committees to discuss the impact assessment, and if necessary give feedback to the compiler of any omissions or errors.

2) Critical points

2.1 Importance of this document. E.g. is implementation required due to safety deficiencies, statutory requirements, technology changes, document revisions, improved service quality, improved service performance, optimised costs.

Safety deficiencies, cable theft solution and technology changes.

2.2 If the document to be released impacts on statutory or legal compliance - this need to be very clearly stated and so highlighted.

N/A

2.3 Impact on stock holding and depletion of existing stock prior to switch over.

Existing stock will still be used.

2.4 When will new stock be available?

Soon as t this document is published.

2.5 Has the interchangeability of the product or item been verified - i.e. when it fails is a straight swop possible with a competitor's product?

Yes

2.6 Identify and provide details of other critical (items required for the successful implementation of this document) points to be considered in the implementation of this document.

N/A

2.7 Provide details of any comments made by the Regions regarding the implementation of this document.

None

3) Implementation timeframe

3.1 Time period for implementation of requirements.

N/A

3.2 Deadline for changeover to new item and personnel to be informed of DX wide change-over.

No deadline.

4) Buyers Guide and Power Office

4.1 Does the Buyers Guide or Buyers List need updating?

Buyer's guide to be created

4.2 What Buyer's Guides or items have been created?

New buyer's guide to be created

4.3 List all assembly drawing changes that have been revised in conjunction with this document.

N/A, new document

4.4 If the implementation of this document requires assessment by CAP, provide details under 5

4.5 Which Power Office packages have been created, modified or removed?

None

5) CAP / LAP Pre-Qualification Process related impacts

5.1 Is an ad-hoc re-evaluation of all currently accepted suppliers required as a result of implementation of this document?

No

5.2 If NO, provide motivation for issuing this specification before Acceptance Cycle Expiry date.

New specification

5.3 Are ALL suppliers (currently accepted per LAP), aware of the nature of changes contained in this document?

N/A

5.4 Is implementation of the provisions of this document required during the current supplier qualification period?

N/A

5.5 If Yes to 5.4, what date has been set for all currently accepted suppliers to comply fully?

N/A

5.6 If Yes to 5.4, have all currently accepted suppliers been sent a prior formal notification informing them of Eskom's expectations, including the implementation date deadline?

N/A

5.7 Can the changes made, potentially impact upon the purchase price of the material/equipment?

Yes

5.8 Material group(s) affected by specification: (Refer to Pre-Qualification invitation schedule for list of material groups)

Tinned copper and Galvanised steel wire

6) Training or communication

6.1 Is training required?

No

6.2 State the level of training required to implement this document. (E.g. awareness training, practical / on job, module, etc.)

N/A

6.3 State designations of personnel that will require training.

N/A

6.4 Is the training material available? Identify person responsible for the development of training material.

N/A

6.5 If applicable, provide details of training that will take place. (E.G. sponsor, costs, trainer, schedule of training, course material availability, training in erection / use of new equipment, maintenance training, etc).

N/A

6.6 Was Technical Training Section consulted w.r.t module development process?

N/A

6.7 State communications channels to be used to inform target audience.

Through Operating Units

7) Special tools, equipment, software

7.1 What special tools, equipment, software, etc will need to be purchased by the Region to effectively implement?

None

7.2 Are there stock numbers available for the new equipment?

To be created.

7.3 What will be the costs of these special tools, equipment, software?

8) Finances

8.1 What total costs would the Regions be required to incur in implementing this document? Identify all cost activities associated with implementation, e.g. labour, training, tooling, stock, obsolescence

Comment:

……

……

……

Impact assessment completed by:

Name: Jutas Maudu

Designation: Senior Engineer