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TITLE **SPECIFICATION FOR COPPER-CLAD STEEL CONDUCTOR**

REFERENCE **CP_TSSPEC_202** REV **2**
DATE: **APPRIL 2025**
PAGE: **1** OF **15**

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FOREWORD

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INTRODUCTION

Copper is a preferred material for earthing systems due to favourable corrosion resistance and high conductivity as compared to alternative materials. Due to the relatively high scrap value and the accessibility of most earthing systems, there is a high risk of theft associated with these systems. It is clear that the risk of copper theft extends to all electrical installations in the City Power area of supply.

Copper Cladded Steel is preferred as an alternative material that meets the technical requirements, yet possesses essentially no scrap value, and as such should dramatically curb theft.

1 SCOPE

This specification details City Power's specific requirements for Copper Clad Steel wire that may be utilised in all electrical installations for the purpose of earthing.

2 NORMATIVE REFERENCES

The following standards and specifications contain provisions that, through reference in the text, constitute requirements of this specification. At the time of publication the editions indicated were valid. All standards and specification are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards and specification listed below.

IEEE 80 *Guide for safety in AC substations grounding*

NRS 102 *Theft Deterrent Earthing Materials*

ASTM B910 *Specification for soft annealed copper clad steel wire*

ASTM B193 *Test Method for Resistivity of Electrical Conductor Materials*

CP_TSSPEC_055 *Specification for an exothermic welding system*

3 DEFINITIONS AND ABBREVIATIONS

The definitions and abbreviations in the above documents shall apply to this specification.

IACS: International Annealed Copper Standard

4 REQUIREMENTS

4.1 General

4.1.1 Nothing in this specification shall lessen the obligations of the supplier. The supplier shall be fully responsible for the design and manufacture of the copper clad steel wire and its satisfactory performance in service. This specification shall be in accordance with ASTM B910; NRS 102 and IEEE 80.

4.2 Annealed Copper clad steel conductors

4.4.1 Material: The wire shall consist of a core of homogenous open-hearth, electric-furnace, or basic-oxygen steel with a continuous outer cladding of copper thoroughly bonded to the core throughout. The copper clad steel shall be manufactured in accordance to ASTM B910.
Only Copper Clad Steel wire that is 40% conductivity shall be accepted by City Power.

4.4.2 Tensile strength and elongation: The copper-clad steel wire shall conform to the tensile strength requirements of Table1. The elongation shall be a minimum of 15% for all diameters.

4.4.3 Adhesion and surface defects: The copper clad steel wire shall not reveal any seams, pits, slivers, or other imperfection of sufficient magnitude to indicate inherent defects or imperfections.

4.4.4Joints: The finished wire shall contain no joints or splices.

4.4.5 Finish: The wire shall be free from copper discontinuities and all imperfections.

4.4.6 Copper Thickness: The minimum copper thickness due to eccentricity shall not be less than the values shown in Table 1.

4.4.7 Resistivity: The electrical resistivity at a temperature of 20°C shall not exceed the values prescribed in Table 1.

Nominal Conductivity [%IACS]	Normal Density [g/cm^3]	Maximum Resistivity at 20°C [Ωmm^2/m]	Minimum Conductivity [%IACS]
40	8.21	0.0440	39.21

Table 1: Density and Resistivity at 20°C

Nominal Conductivity [%IACS]	Minimum Tensile Strength [N/mm^2]	Minimum Copper Thickness [% of Diameter]	Nominal Copper Thickness [% of Diameter]
40	276	5.0	9

Table 2: Tensile and Minimum Copper Thickness

4.3 Connection types

Exothermic connections are recommended wherever practical for the following reasons:

a. Optimum conductor utilization resulting in less conductor cross-sectional area being required
b. No maintenance requirements since there is no connection interface for corrosion
c. High mechanical integrity

With exothermic connections it shall be ensured that the connections are performed by an accredited contractor and that all connections are quality checked. If correctly done, exothermic connections are the most reliable connection, requiring no maintenance.

If for some reason e.g. in cable basements, exothermic connections cannot be utilized and bolted connections are used, these connections should be applied according to SANS 1063.

5 TESTS

6.1 Tensile Strength and Elongation: This shall be determined in accordance with the Test Method laid out in ASTM B910. The test report shall be submitted.

6.2 Resistivity: This shall be determined in accordance with Test method ASTM B293 and a report shall be submitted.

6.3 Dimensional Measurements: This shall be determined in accordance with the Test Method laid out in ASTM B910. The test report shall be submitted.

6.4 Torsion [twist] Test: This shall be determined in accordance with the Test Method laid out in ASTM B910. The test report shall be submitted.

6.5 Finish: This shall be determined in accordance with the Test Method laid out in ASTM B910. The test report shall be submitted.

6.6 Copper Thickness: This shall be determined in accordance with the Test Method laid out in ASTM B910. The test report shall be submitted.

6 PACKAGING AND MARKING

7.1 Packaging

7.1.1 The copper-clad steel wire shall be securely strapped or bound together on 500 m length drums.

7.1.2 The ends of the copper-clad steel wire shall be wrapped or covered in protective material to prevent damage during handling, transportation and storage.

7.2 Marking

The copper-clad steel wire shall be appropriately marked so as to distinguish the wire from copper or other similar materials.

7 DOCUMENTATION

6.1 Technical product catalogue and operating and installation manuals shall be provided

6.2 Full detailed dimensions drawings shall be provided.

6.3 Full detailed data sheet.

6.4 A copy of all type test reports shall be provided.

6.5 A copy of the proposed routine test reports shall be provided.

8 TRAINING

9.1 The following certified training courses, for City Power's staff, shall be provided:

9.1.1 Installation, jointing and

9.1.2 Testing of the copper-clad steel wire earthing continuity

9.2 The associated costs for the certified training courses in 9.1 shall be given per person and shall be fixed for the period of the contract.

9 QUALITY MANAGEMENT

A quality management plan shall be set up in order to assure the proper quality management of the theft deterrent materials services during design, development, production, installation and servicing phases. Guidance on the requirements for a quality management plan may be found in the ISO 9001:2015. The details shall be subject to agreement between City Power and the Supplier.

10 ENVIRONMENTAL MANAGEMENT

An environmental management plan shall be set up in order to assure the proper environmental management of the theft deterrent materials throughout its entire life cycle (i.e. during design, development, production, installation, operation and maintenance, decommissioning and disposal phases). Guidance on the requirements for an environmental management system may be found in ISO 14001:2015 standards. The details shall be subject to agreement between City Power and the Supplier. This is to ensure that the asset created conforms to environmental standards and City Power SHERQ Policy

11 HEALTH AND SAFETY

A health and safety plan shall be set up in order to ensure proper management and compliance of the theft deterrent materials during installation, operation, maintenance, and decommissioning phases. Guidance on the requirements of a health and safety plan may be found in ISO 45001:2018 standards. This is to ensure that the asset conforms to standard operating procedures and City Power SHERQ Policy. The details shall be subject to agreement between City Power and the Supplier.

Annex A – Bibliography

None

Annex B - Revision information

DATE	REV. NO.	NOTES
June 2014	0	First issue
March 2022	1	Added new study committee General Editing
April 2025	2	Added new study committee General Editing

ANNEX- TECHNICAL SCHEDULE A AND B

ITEM 1: 16 mm^2 CCS Wire copper equivalent: SAP No. 2971

Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub clause of CP_TSSPEC_202	Description		Schedule A	Schedule B
1		Name of manufacturer		XXXX	
2		Place of manufacture		XXXX	
3		Manufacturer's identification reference		XXXX	
4		Specification to which earth CCS complies		NRS 102 /ASTM B910	
		General			
5		Method of coupling		Exothermic welding	
6		Corrosion withstand	Years	40	
7		Copper-clad steel wire compatible to exothermic welding	Yes/No	Yes	
		Mechanical requirements			
8		Comply to percussion strength (Test report included)		Required	
9		Comply to tensile strength (Test report included)		Required	
10		Comply to bending strength (Test report included)		Required	
11a)		Minimum thickness of copper on steel core	% of Diameter	5	
11b)		Nominal thickness of copper to steel core	% of Diameter	9	
12		Length of copper-clad steel wire (wooden drum)	m	500	
13		Copper-clad steel wire overall diameter	mm	12.94 max	
14		Tests comply to ASTM B910 and B293 (Report)	Yes/No	Required	

NOTE: TICKS [✓✗], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.

Tender Number: _____

Tenderer's Authorised Signatory: _____ _____
Name in block letters Signature

Full name of company: _____

Annex C – Technical schedule A and B for 16 mm^2 CCS Wire copper equivalent – **Continued: SAP 2971**

Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub clause of CP_TSSPEC_202	Description		Schedule A	Schedule B
		Packaging and Marking			
15	6.1	Comply to packaging requirements	Yes/No	Yes	
16	6.2	Comply to marking requirements	Yes/No	Yes	
		Colour of the product	Treated	Not resembling copper	
17	7	Documentation provided		Required	
18	8	Training required		Required	
19	9	Quality management accreditation		Required	
20	10	Environmental management accreditation		Required	
21	11	Health and Safety accredation		Required	

NOTE: TICKS [✓✗], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.

Tender Number: _____

Tenderer's Authorised Signatory: _____ _____

Name in block letters Signature

Full name of company: _____

DEVIATION SCHEDULE

ITEM 1:16 mm^2 CCS Wire copper equivalent: SAP 2971Deviation schedule

Any deviations offered to this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified by City Power.		
Item	**Sub clause of CP_TSSPEC_202**	**Proposed deviation**

Tender Number: _____

Tenderer's Authorised Signatory: _____ _____

Name in block letters Signature

Full name of company: _____

ITEM 2: 70 mm^2 CCS Wire copper equivalent: SAP 2972

Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub clause of CP_TSSPEC_202	Description		Schedule A	Schedule B
1		Name of manufacturer		XXXX	
2		Place of manufacture		XXXX	
3		Manufacturer's identification reference		XXXX	
4		Specification to which earth CCS complies		NRS 102 /ASTM B910	
		General			
5		Method of coupling		Exothermic welding	
6		Corrosion withstand	Years	40	
7		Copper-clad steel wire compatible to exothermic welding	Yes/No	Yes	
		Mechanical requirements			
8		Comply to percussion strength (Test report included)		Required	
9		Comply to tensile strength (Test report included)		Required	
10		Comply to bending strength (Test report included)		Required	
11		Minimum thickness of copper on steel core	% of Diameter	5	
		Nominal thickness of copper on steel core	% of Diameter	9	
12		Length of copper-clad steel wire (wooden drum)	m	500	
13		Copper-clad steel wire overall diameter	mm	23.5 max	
14		Tests comply to ASTM B910 and B293 (Report)	Yes/No	Required	

NOTE: TICKS [✓✕], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.

Tender Number: _____

Tenderer's Authorised Signatory: _____ _____

Name in block letters Signature

Full name of company: _____

ITEM 2: 70 mm^2 CCS Wire copper equivalent: SAP 2972 (Continued)

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub clause of CP_TSSPEC_202	Description		Schedule A	Schedule B
		Packaging and Marking			
17	6.1	Comply to packaging requirements	Yes/No	Yes	
18	6.2	Comply to marking requirements	Yes/No	Yes	
		Colour of the product	Treated	Not resembling copper	
19	7	Documentation provided		Required	
20	8	Training required		Required	
21	9	Quality management accreditation		Required	
22	10	Environmental management accreditation		Required	

NOTE: TICKS [✓✕], ASTERISK [*], WORD [NOTED], OR TBA [TO BE ADVISED] WILL NOT BE ACCEPTED.

Tender Number: _____

Tenderer's Authorised Signatory: _____ _____

Name in block letters Signature

Full name of company: _____

DEVIATION SCHEDULE

ITEM 2: 70 mm^2 CCS Wire copper equivalent: SAP 2972

Any deviations offered to this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified by City Power.		
Item	**Sub clause of CP_TSSPEC_202**	**Proposed deviation**

Tender Number: _____

Tenderer's Authorised Signatory: _____ _____

Name in block letters Signature

Full name of company: _____

ANNEX D -STOCK ITEMS

Item	SAP No.	SAP Short Description	SAP Long Description
1	2971	CAB CCS Cu equivalent 1C uninsulated	Copper Clad Steel wire equivalent to 16 mm^2 bare copper, but with 40% IACS conductivity, manufactured through a metallurgical process and comprises solid oxygen –free copper and steel core. Item specification number is CP_TSSPEC_202.
2	2972	CAB CCS 70 Cu equivalent 1C uninsulated	Copper Clad Steel wire equivalent to 70 mm^2 bare copper, but with 40% IACS conductivity, manufactured through a metallurgical process and comprises solid oxygen –free copper and steel core. Item specification number is CP_TSSPEC_202.