DOCUMENT NO.: KP1/6C/4/1/TSP/03/005-1



Kenya Power

PRESTRESSED CONCRETE POLES WITHOUT HOLES AND WITHOUT JOINTS, WITH OR WITHOUT EARTHING - SPECIFICATION

A Document of The Kenya Power & Lighting Co. Ltd.

June 2018

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0.1 CIRCULATION LIST

COPY NO.	COPY HOLDER
1	Manager, Standards
2	Electronic copy (pdf) on Kenya Power server (http://172.16.1.40/dms/browse.php?fFolderId=23)

REVISION OF KPLC STANDARDS

In order to keep abreast of progress in the industry, KPLC Standards shall be regularly reviewed. Suggestions for improvements to approved Standards, addressed to the Manager, Standards department, are welcome.

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0.2 AMENDMENT RECORD

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
Issue 2 Rev 0	2015-12-08	Cancels and replaces Issue 1 Rev 0 dated 07-07-2005	S. Nguli	Dr. Eng. Peter Kimemia
Issue 2 Rev 1	2016-06-23	Tables 1,2,3,4 and 5 were inserted	S. Nguli J. Ng'ang'a	Dr. Eng. Peter Kimemia
Issue 3 Rev 0	2018-06-29	1. Adopted the new format of specification writing 2. Inserted test requirements of proof load and sampling 3. Introduce marking by stamping 4. Add cover over concrete requirement	N. Wairimu J. Ndirangu S. Nguli	Dr. Eng. Peter Kimemia

FOREWORD

This specification has been prepared by the Standards Department of the Kenya Power & Lighting Co. Ltd. (KPLC) and it lays down requirements for Concrete Poles for use on overhead power lines. It is intended for use by the company in purchasing Concrete Poles.

The specification has been reviewed to enhance it by introducing:

a) Requirement for proof load tests and cover over concrete
b) Improvement in sampling
c) Marking for conductivity hazard and centre of gravity
d) Marking by stamping.

The other specifications in this series are:

KP1-3CB-TSP-03-005-2: Specification for concrete poles- Part 2- prestressed concrete poles with holes (10m-12m)

KP1-3CB-TSP-03-005-3: Specification for concrete poles – Part 3 – Reinforced concrete poles 8m and above

The specification stipulates the minimum requirements for concrete poles with earthing and without earthing acceptable for use in the company. It shall be the responsibility of the manufacturer to ensure adequacy of the design, good workmanship and good engineering practice in the manufacture of the concrete poles for KPLC.

The following are members of the team that reviewed this specification:

Name	Designation	Department
Eng. Julius Ndirangu	4th Assistant Engineer	Standards
Nancy Wairimu	4th Assistant Engineer	Standards
Eng. Stephen Nguli	Senior Engineer	Standards

1. SCOPE

1.1. This specification is for Prestressed Concrete Poles Without Holes & Without Joints, With or Without Earthing, for use on the overhead power line distribution system and for installing pole mounted substations, Line Switchgear and Equipment.

1.2. The specification covers pole sizes 10m, 11m, 12m, 14m and 15m.

1.3. The specification also covers requirements, sampling, inspection and tests of the concrete poles as well as schedule of Guaranteed Technical Particulars.

2. NORMATIVE REFERENCES

The following standards contain provision which through reference in this text constitute provisions of this specification. For dated editions the cited edition shall apply; for undated editions the latest edition of the referenced documents shall apply.

KS 1933:2005	Kenya Standard – Concrete Poles for Telephone, Power and Lighting Purposes – Specification.
KS 95:2003	Kenya Standard – Specification for Natural aggregates for use in concrete
KS EAS 18-1:2001	Kenya Standard – Cement- Part 1: Composition, specification and conformity criteria for common cement.

3. DEFINITIONS, SYMBOLS AND ABBREVIATIONS

For the purpose of this specification the definitions and abbreviations given in the reference standards shall apply and the following abbreviations:

Abbreviations

H.S bar:	Horizontal Steel bars
KPLC:	Kenya Power & Lighting Co. Ltd.
KS:	Kenya Standard
SC:	Strength class
L:	Length of the pole
C:	Clamping length
H:	Length of the pole above the clamping length
SF:	Safety factor
ϕ :	Diameter

4. REQUIREMENTS

4.1. Service Conditions

The concrete poles shall be suitable for continuous outdoor use in tropical areas and harsh climatic conditions including areas exposed to:

a) Altitudes of up to 2200m above sea level;
b) Humidity of up to 95%;
c) Average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C
d) Pollution: Design pollution level to be taken as "Heavy" (Pollution level III) for inland and "Very Heavy" (Pollution level IV) for coastal applications.
e) Isokeraunic levels of up to 180 thunderstorm days per year.

4.2. Materials and Construction

4.2.1. The concrete poles shall be designed, manufactured and tested to KS 1933 and the requirements of this specification. The earthing details shall be as per this specification.

4.2.2. The poles shall be round, pre-stressed concrete poles and suitable for direct embedment into the ground without special foundations as per KS 1933.

4.2.3. The pole shall be so designed that its strength in transverse direction shall be sufficient to take the load due to wind on conductors, fittings and the pole.

4.2.4. The mix design, mixing and compaction of the concrete shall be such that the necessary strength in the pole is obtained after curing in accordance with KS 1933.

4.2.5. Materials for concrete used in the manufacture of concrete poles shall be selected to produce high density, low porosity poles. They include cement, sand, course aggregate and water. The concrete shall be as per Table 1

Table 1: Concrete components

Component	Specification
Cement	At least strength Class 42.5 as per KS EAS 18-1:2001.
Sand	Clean uncrushed gravel sand (River sand) passing a 5.0 mm KS 770 test sieve as per KS 95:2003
Coarse aggregate/Ballast	Machine crushed as retained in a 5.0 mm KS 770 test sieve as per KS 95:2003
Mixing Water	Shall be free from impurities that could impair the strength or durability (or both) of the poles.

4.2.6. Coarse aggregate shall be free from veins and adherent coating and free from injurious amount of disintegrated pieces, alkali, vegetable matter and other deleterious substances. As far as possible, flaky and elongated pieces shall be avoided.

4.2.7. Concrete shall be compacted by vibration, centrifugation or other efficient means. Hand compaction shall not be permitted.

4.2.8. The surface of all reinforcement shall be free from loose or heavy rust, scale, oil, grease, clay or other material that may have deleterious effect on the bond between the reinforcement and concrete.

4.2.9. The finished pole shall have a smooth external surface that is free from honeycombing. All arises shall be clean and true and shall have a neat appearance.

4.2.10. All the reinforcement bars shall be covered by concrete and none shall be visible on the surface, save for those protruding from the bottom of the pole, the butt end.

4.3. Poles with Integral Earthing

4.3.1. For a concrete poles with earthing, it shall incorporate an integral earthing system in accordance with Drawing Number TSP/03/05-11 and TSP/03/05-12 in Annex A. The quantities of earthed concrete poles required shall be stated in each tender.

4.3.2. The manufacturer shall supply the poles complete with stainless steel bonding M12 bolts with spring and flat washers. These shall be screwed firmly into the earthing ferrule as per drawing no. TSP/03/05-12

4.3.3. The stainless-steel bolts and washers shall be fixed after the pole is cured and ready for dispatch to KPLC stores

4.3.4. The complete stainless-steel bolts and earthing ferule shall be greased with neutral grease to ease unscrewing at site.

4.4. Design Parameters

4.4.1. Pole taper for each concrete pole shall be 13mm per meter.

4.4.2. The minimum design requirements shall be as per Table 2 for class 25, 50 and 75 SC.

Note. The manufacture shall submit drawings with tender to confirm the design offered

4.5.Length and Strength Combination

4.5.1. The required minimum safety factor (S.F) is 2.

4.5.2. The concrete poles shall conform to the following standard sizes and strengths as per Table 3 for class 25, 50 and 75SC.

Table 2: Pole design parameters for 25SC, 50SC and 75SC

Pole size(m)		10	11	12	14	15
Spiral ϕ wire(mm)		3	3	3	3	3
Ring bar ϕ (mm)		6	6	6	6	6
H.S bar ϕ(mm)	**25SC**	5	5	5	5	5
	50SC	5.0	5.0	5.0	5.0	5.0
	75SC	7.0	7.0	7.0	7.0	7.0
No. of H.S bar		14	16	18	22	24
Spacing of ring bar (tip to bottom (mm)		500	500	500	500	500
Spacing of spiral wire(mm)		Tip <50 Centre <75 Bottom<50	Tip <50 centre <75 Bottom<50	Tip <50 Centre <75 Bottom<50	Tip <50 Centre <75 Bottom<50	Tip <50 Centre <75 Bottom<50
Top Diameter		190	190	190	190	190
Butt ϕ, min. (mm)		320	333	346	372	385
Average Thickness of Butt(mm)		55	55	55	55	55
Cover over Reinforcement, measured from the surface of the pole, (mm)		30	30	30	30	30

Table 3: Length and Strength combination parameters as per KS 1933

Pole Length L(M)	Ground Line(M) C=0.1L+0.6	Strength Class					
		25SC		50SC		75SC	
		Proof Load (kN)	Ultimate Load (kN)	Proof Load (kN)	Ultimate Load (kN)	Proof Load (kN)	Ultimate Load (kN)
10	1.6	1.38	2.50	2.75	5.00	4.13	7.50
11	1.7	1.51	2.75	3.03	5.50	4.54	8.25
12	1.8	1.65	3.00	3.30	6.00	4.95	9.00
14	2	1.93	3.50	3.85	7.00	5.78	10.50
15	2.1	2.06	3.75	4.13	7.50	6.19	11.25

4.6. Color Codes

4.6.1. Each pole shall be colour coded to facilitate size identification during handling and storage. The paint used for colour coding shall be indelible and in accordance with the Table 4 below.

Table 4: Color Codes

STANDARD POLE LENGTH (M)	COLOUR OF PAINT
10.0	GREEN
11.0	NAVY BLUE
12.0	YELLOW
14.0	RED
15.0	SKY BLUE

4.6.2. All poles shall have a ring 50mm from the tip, marked with the same colour, to indicated position of fixing the cross-arm.

5. TEST REQUIREMENTS

5.1. The concrete poles shall be inspected and tested in accordance with the requirement of KS 1933 and this specification.

5.2. The tests shall include overall length, confirmation of size and number of ferrules, straightness, proof load and ultimate load.

5.3. The length of the pole shall be measured to the nearest 5mm and the measured length shall not differ from the specified length by more than 50mm.

5.4. The tip dimension of the pole shall be measured to the nearest 1mm and the measured dimension shall not differ from the dimension stated by the manufacturer by more than 3mm.

5.5. When a pole is tested under the proof load appropriate to the pole length and the strength class as per KS 1933, it shall comply with the requirements in Table 5

5.6. When a pole is tested under the ultimate load appropriate to the pole length and the strength class as per KS 1933, it shall comply with the requirements in Table 3.

6. SAMPLING

6.1. In a consignment, 500 poles or a part thereof of the same overall length, same dimensions and belonging to the same batch of manufacture shall be grouped together to constitute a lot.

6.2. For ascertaining the conformity of the poles in the consignment to the requirements of this specification, samples shall be tested from each lot separately.

6.3. The number of poles to be selected from the lot shall depend on the size of the lot and shall be according to the sampling Table 6 below.

6.4. For ascertaining the conformity of the poles in the consignment to the requirements of this specification, samples shall be tested from each lot separately.

6.5. The number of poles to be selected from the lot shall depend on the size of the lot and shall be according to the sampling Table 6 below.

6.6. All the poles selected according to 6.3 shall be tested for defects, physical dimensions and straightness as per KS1933. A pole failing to satisfy one or more of these requirements shall be considered as defective. All the poles in the lot shall be considered as conforming to these requirements if the number of defective poles found in the sample is less than or equal to the corresponding acceptance number given in Column 3 of the sampling table.

6.7. The lot having been found satisfactory according to 6.4 shall be further tested for proof strength and ultimate load of the poles. For this purpose, the number of poles given in column 4 of the sampling table shall be tested, these poles may be selected from those already tested according to 6.4 and found satisfactory. All these poles tested for proof strength and ultimate load shall satisfy the corresponding specification requirements. If one or more poles fail, twice the number of poles required for proof strength and ultimate load tests shall be selected from the lot again and subjected to this test. If there is no failure among these poles, the lot shall be considered to have satisfied the requirements of this test. If there is failure, then the entire lot shall be rejected.

Table 5: Proof load test

Length of Pole (L) in Metres	Clamping Length(C), m		Deflection of pole tip at proof load <=5%H, mm	Crack width at proof load	Permanent Set -<=10%	Failure Load
	C=0.1L+0.6	H =L-C				
10	1.6	8.4	0.42	Not Visible	0.042	No Failure
11	1.7	9.3	0.465	Not Visible	0.0465	No Failure
12	1.8	10.2	0.51	Not Visible	0.051	No Failure
14	2.0	12	0.6	Not Visible	0.06	No Failure
15	2.1	12.9	0.645	Not Visible	0.0645	No Failure

Table 6: Sampling Table

No. of poles in the lot	Sample size	Defects and Dimensional Requirements acceptance number	Proof of Strength Test	Ultimate load test
Up to 100	10	1	2	1
101 to 200	15	1	3	1
201 to 300	20	2	4	1
301 to 500	30	3	5	2

7. MARKING

7.1. Each concrete pole shall be marked permanently by impressing or permanently stamping on the pole at a position 1.5m above the pole Ground line with the following details.

a) Manufacturer's name and mark
b) Date of manufacture (mm/yy)
c) Length of pole (meters) and Tip dimensions (mm)
d) Ultimate/Working load/Strength Class
e) Type of pole
f) Weight of pole
g) Standard to which the pole complies
h) The words "PROPERTY OF KPLC"

(g) The strength class of each pole shall be indicated by stamping 1.7m above the ground line the words 'XXSC' where XX is the strength class of the pole. The height of the letters shall be 50mm

7.2. Ground line reference mark as determined in 4.4.2 shall be painted conspicuously on the pole. It shall be colour coded according to Table 4. The ground line may also be marked by impressing on the pole.

7.3. A centre of gravity mark shall be impressed on the pole in order to ease lifting of the pole from a single pick up point and two other off-centre pick-up point shall be similarly marked for two-point lifting of the pole on the horizontal position. The symbol shall be as per figure 1 whose dimensions shall be 20cm x 20cm and shall be conspicuous on the pole.

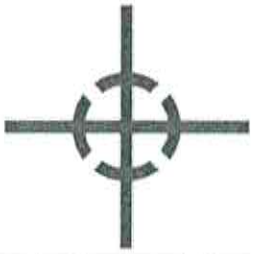


Figure 1: Center of Gravity mark

7.4. In order to warn on dangers of conductivity each concrete pole shall be marked with the electrical hazard symbol by permanently stamping or impressing on the pole at a position 1.7m above the pole Ground line. The electric symbol as shown in figure 2 dimensions shall be 20cm x 20cm and shall be conspicuous on the pole. This shall be painted in RED permanent colour.



Figure 2: Electric Symbol

7.5. In all cases the lettering shall be not less than 100mm high, legibly impressed.

8. WARRANTY

The manufacturer shall warrant its poles against defects in material and workmanship within a period of 60 months from the date of delivery, providing a joint inspection between Kenya Power and the manufacturer determines any pole to be defective under the terms of the warranty covering replacement and disposal of such defective poles free of cost.

APPENDICES

A. DRAWINGS (NORMATIVE)

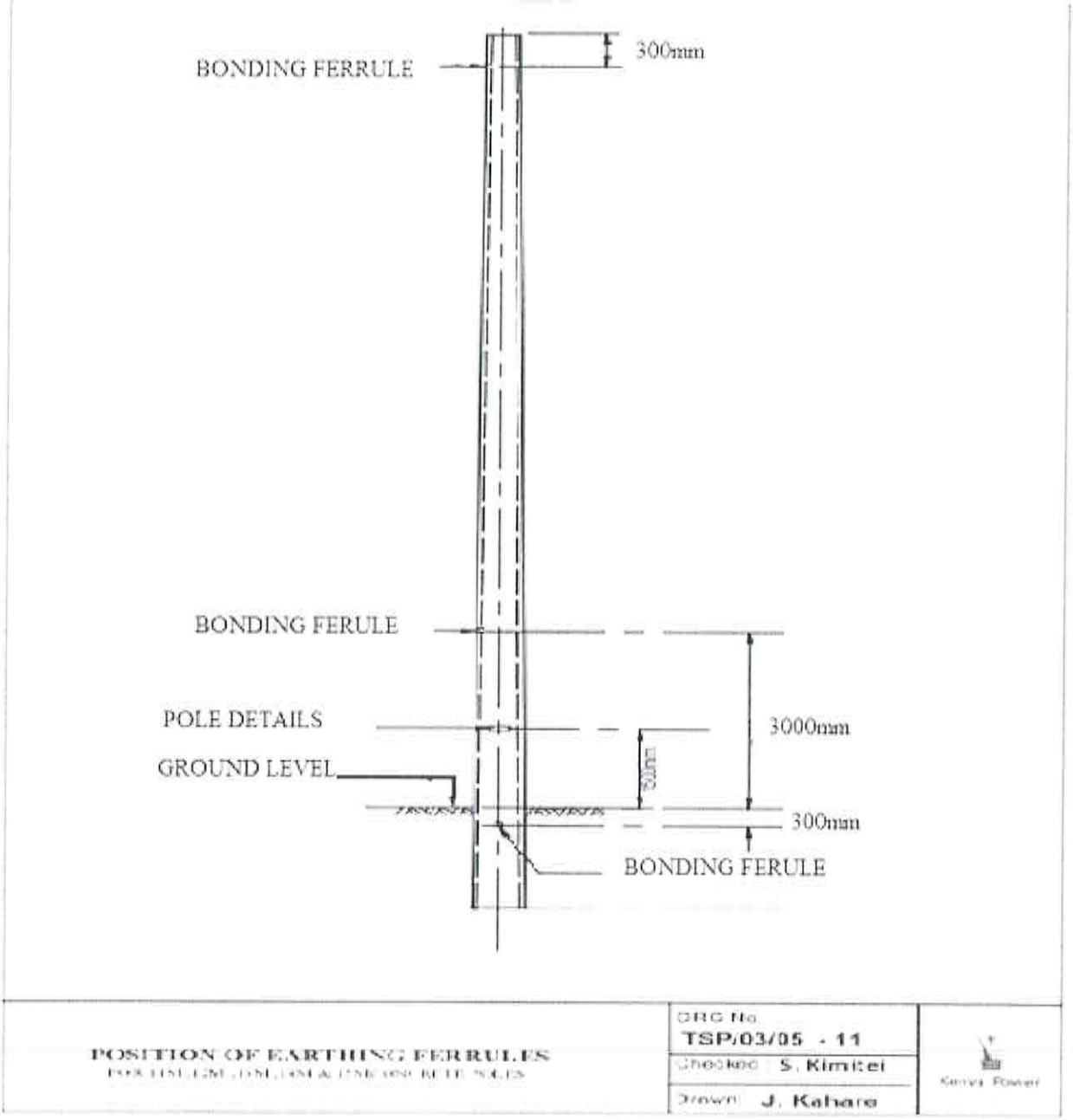


Fig. 1 – Pole design dimensions

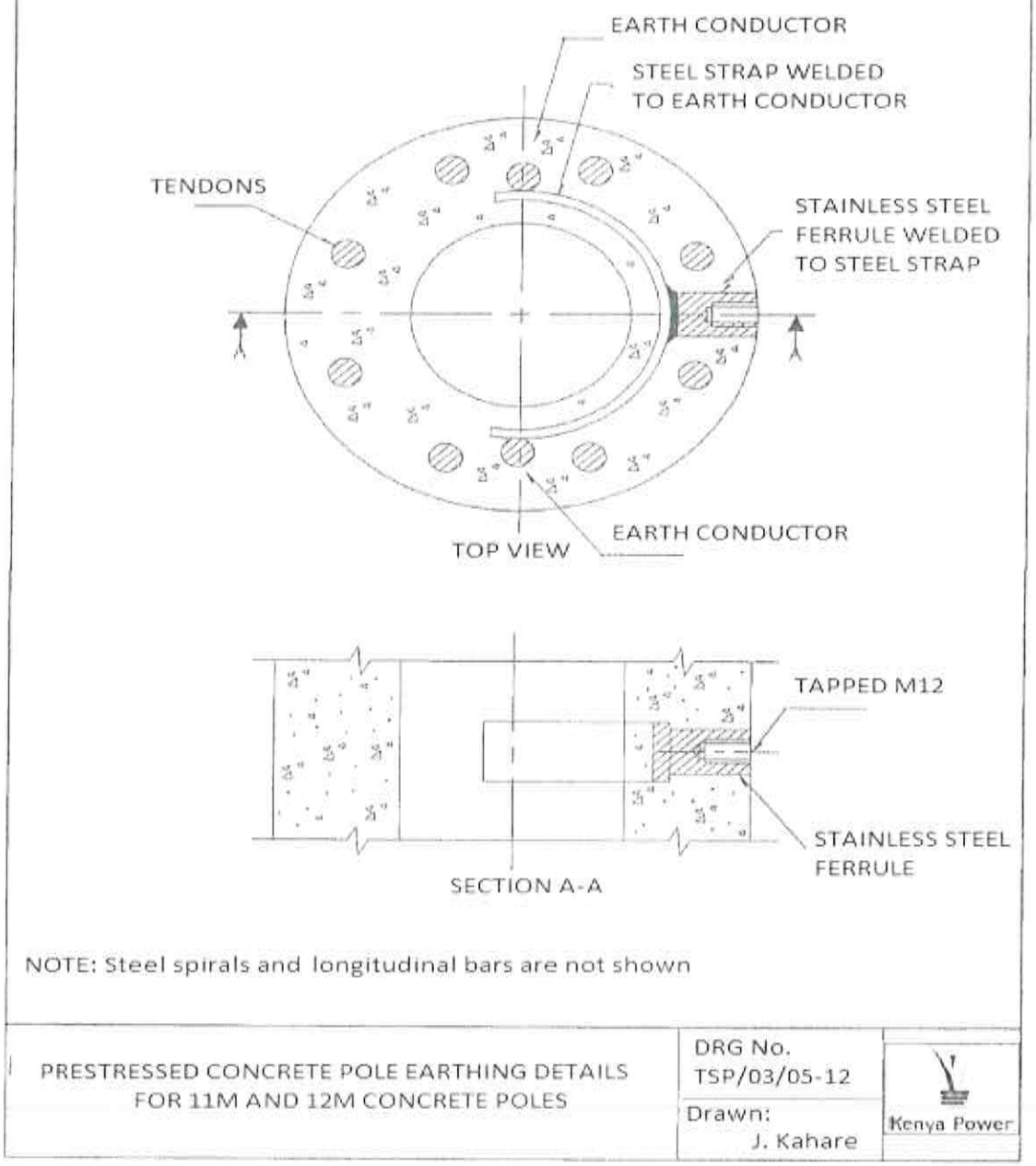


Fig. 2 – Concrete pole earthing details

B. TESTS AND INSPECTION (NORMATIVE)

B.1 It shall be the responsibility of the manufacturer to perform or to have performed all the tests specified.

B.2 Copies of previous Test Certificates and Test Reports issued by a third-party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical evaluation. The Test Reports to be submitted with the tender shall not be more than five years old. A copy of accreditation certificate for the third-party testing laboratory shall also be submitted with the tender (all in English Language).

B.3 After manufacture, Sampling, Inspection and Methods of Test shall be in accordance with KS 1933 and this specification. The tests shall be done at the manufacturer's works in the presence of KPLC Engineers. Complete test reports for the poles shall be submitted to KPLC for approval before delivery. The test reports shall include ultimate load test.

B.4 Upon delivery of the concrete poles, KPLC will inspect them and may perform or have performed any of the relevant tests in order to verify compliance with the specification. The supplier shall replace/rectify without extra or additional charge to KPLC, concrete poles which upon examination, test or use fail to meet any of the requirements in the specification and reference standards.

C. QUALITY MANAGEMENT SYSTEM (NORMATIVE)

C.1 The supplier shall submit with the tender a quality assurance plan (QAP) that will be used to ensure that the concrete poles material, manufacture, workmanship, tests, service capability, maintenance and documentation, will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008 or later and the Diamond Mark of Quality for locally produced poles.

C.2 The Manufacturer's Declaration of Conformity to reference standards and copies of quality management certifications including copy of valid and relevant ISO 9001:2008 or later certificate (and for locally manufactured poles, the Diamond Mark of Quality from KEBS) shall be submitted with the tender for evaluation.

D. DOCUMENTATION (NORMATIVE)

D.1 The bidder shall submit its tender complete with technical documents required by Appendix E (Guaranteed Technical Particulars) for tender evaluation. The technical documents to be submitted (all in English language) for tender evaluation shall include the following:

a) Fully-filled clause by clause Guaranteed Technical Particulars (GTPs) - Appendix D - stamped and signed by the manufacturer.
b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data;
c) Quality assurance plan (QAP) that will be used to ensure that the design, material, workmanship, tests, service capability, maintenance and documentation will fulfil the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfil the requirements of ISO 9001:2008 or later.
d) Sales records for the last five years and at least four customer reference letters;
e) Details of manufacturing capacity and the manufacturer's experience;
f) Copies of required test reports by a third-party testing laboratory accredited to ISO/IEC 17025. The test reports shall not be more than five years old.
g) Copy of accreditation certificate for the testing laboratory.

D.2 The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Co. Ltd for approval before manufacture:

a) Fully filled clause by clause Guaranteed Technical Particulars (GTPs) stamped and signed by the manufacturer **(these are not the ones submitted with the tender)**;
b) Detailed hard copy Design Drawings with details of concrete poles to be manufactured for KPLC,
c) Detailed test program to be used during factory testing,
d) Marking details and method to be used in marking the concrete poles
e) Manufacturer's undertaking to ensure adequacy of the design, good engineering practice, adherence to the specification and applicable standards and regulations as well as ensuring good workmanship in the manufacture of the concrete poles for The Kenya Power & Lighting Co. Ltd.

E. GUARANTEED TECHNICAL PARTICULARS (NORMATIVE)

(to be filled, stamped and signed by the Supplier and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, sales records for previous five years, four customer reference letters, details of suppliers' capacity and experience; and copies of complete test certificates and test reports for tender evaluation or approval, all in English Language, as per clauses D.1 and D.2)

Tender No. .....

Bidder's Name.....

Clause	Guaranteed Technical Particulars		Bidder's offer
	Name and address of the Manufacturer		state
	Country of manufacture		state
	Manufacturer's Letter of Authorization		provide
	Model/Type Reference No. of the offered poles		state
	Drawing Reference Number		state
	Manufacturer's warranty and guarantee certificate for the offered poles		Provide
1.0	Type and Size of concrete poles		state
2.0	Reference Standard of manufacture		state
3.0	Definitions and abbreviations		specify
4.0	Requirements		
4.1	**Service Conditions**		specify
4.2	**Material and construction**		
4.2.1	Design, manufacture and Test Standard		state
4.2.2	Type of pole offered		state
4.2.3	Traverse direction strength design		State
4.2.4	Design, mixing and compaction of concrete achieves the necessary strength		State
4.2.5	Materials used for concrete produce high density, low porosity poles		State
	Concrete components specification	Cement	Specify
		Sand	Specify
		Coarse aggregate/ Ballast	Specify
		Mixing water	Specify
4.2.6	Coarse aggregate free from deleterious substances		State
4.2.7	Mode of compaction		State

Clause	Guaranteed Technical Particulars						Bidder's offer
4.2.8	Surface of reinforcement free from any material that may affect the bond between the reinforcement and concrete						State
4.2.9	Earthing (conductor material and size, steel strap and stainless-steel ferrules)						Specify/ provide drawing
4.2.10	Cover of concrete on rebars						State
4.3	**Poles with Integral Earthing**						
4.3.1	Integral earthing system including provision of earthing ferrules						State
4.3.2	Stainless steel bonding M12 bolts with spring and flat washers						State
4.3.3	Stainless steel bolts and washers to be fixed after pole is cured						State
4.3.4	Fixing and greasing of the stainless-steel earthing ferule and bolts						State
4.4	**Design parameters**						
4.1.1	Pole taper						State
4.4.2	Minimum design requirements **Table 2: Pole design parameters**						
	Pole size (m)		10	11	12	14	15
	Spiral ϕ wire(mm)		state	state	state	state	state
	Ring bar ϕ (mm)		state	state	state	state	state
	H.S bar ϕ(mm)	25SC	state	state	state	state	state
		50SC	state	state	state	state	state
		75SC	state	state	state	state	state
	No. of H.S bar		state	state	state	state	state
	Spacing of ring bar (tip to bottom (mm)		state	state	state	state	state
	Spacing of spiral wire(mm)		state	state	state	state	state
	Top Diameter		state	state	state	state	state
	Butt ϕ(mm)		state	state	state	state	state
	Average Thickness of Butt(mm)		state	state	state	state	state
4.5	**Length and Strength Combination**						
4.5.1	Minimum factor of safety (S.F)						Specify
4.5.2	Length and strength class combination parameters						Provide detailed drawings as per table 3

Clause	Guaranteed Technical Particulars	Bidder's offer
4.6	**Table 4: Colour codes**	
	Standard pole length	Colour of paint
	10.0	state
	11.0	state
	12.0	state
	14.0	state
	15.0	state
4.6.2	Marking at 50mm from pole with same identification colour	State compliance
5	Test Requirement	
5.1	Test standard	State
5.2	Applicable tests	State
5.3	Tolerance of length of the pole	State
5.4	Tolerance of tip dimension of the pole	
5.5	Proof load test	Provide test reports
5.6	Ultimate load test	Provide test reports
6	Sampling procedure for test	State compliance
7.	Marking (indicate parameters and method of marking to be used during manufacture)	Specify
A	Drawings	Provide
B	Test and Inspection	
B.1	Responsibility of carrying out tests	State
B.2	Copies of previous Test Certificates and Test Reports issued by a third-party testing laboratory that is accredited to ISO/IEC 17025	Provide
B.3	List Acceptance Tests to be witnessed by KPLC Engineers.	List
B.4	Inspection and Acceptance at KPLC stores	State compliance
	Replacement of rejected poles at no extra cost to KPLC	State compliance
C	Quality Management System	
C.1	Quality Assurance Plan	Provide
C.2	Copy of ISO 9001:2008 Certificate/ Diamond Mark of Quality for locally produced poles	Provide
D	Documentation	
D.1	Documents submitted with tender	list

Clause	Guaranteed Technical Particulars	Bidder's offer
D.2	Documents to be submitted to KPLC for approval before manufacture	specify
Other details required with the tender	List of catalogues, brochures, technical data, drawings and customer sales records submitted to support the offer.	specify
	Deviations from tender specifications and supporting data, test reports, technical documents etc.	specify

.....

Manufacturer's Name, Signature, Stamp and Date