

JOHANNESBURG WATER (SOC) Ltd.

BULK WASTEWATER

PARTICULAR SPECIFICATION

**E20 : ELECTRICAL OVERHEAD LINES UP TO
22kV**



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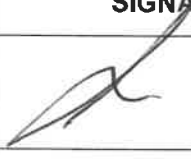
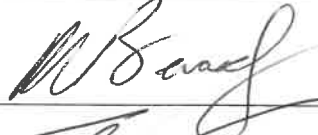

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PARTICULAR SPECIFICATION: VOLUME E20: ELECTRICAL OVERHEAD LINES UP TO 22kV

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E20.2 SCOPE

This specification covers the design, supply, delivery, installation, testing and commissioning of overhead lines up to 22kV.

E20.3 STANDARDS

E20.3.1 Standards

The latest edition, including all amendments to until the date of tender, of the following particular national and international specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- (a) SANS 1200 : Standardized specification for civil engineering construction
- (b) SANS 753 : Pine poles, cross-arms and spacers for power distribution, telephone systems and street lighting
- (c) SANS 754 : Eucalyptus poles, cross-arms and spacers for power distribution and communications systems
- (d) SANS 218 : Radio interference characteristics of overhead power lines and high-voltage equipment
- (e) SANS 10280 : Overhead power lines for conditions prevailing in South Africa
- (f) SANS 1507 : Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)
- (g) SANS 1574 : Electric flexible cables with solid extruded dielectric insulation
- (h) NRS 035 : Drop-out fuse-link assemblies or solid-link assemblies - Pole-mounted types - For nominal ac voltages up to and including 33 kV
- (i) SANS 60269 : Low-voltage fuses
- (j) SANS 60282 : High-voltage fuses
- (k) SANS 182-3 : Conductors for overhead electrical transmission lines

Further to the standards listed above, the distribution line shall also comply with the Occupational Health and Safety Act (No. 85 of 1993).

All material shall adhere to the various ESKOM material specifications for the different assemblies as mentioned in the ESKOM Distribution Standards.

E20.3.2 Particular specifications to be read in conjunction with this specification

The following particular specifications shall be read in conjunction with the product specification:

- (a) E15 : TRANSFORMERS
- (b) E11 : ELECTRICAL EARTHING AND LIGHTNING PROTECTION

E20.4 CONSTRUCTION AND OPERATION REQUIREMENTS

E20.4.1 General

- (a) All overhead distribution lines will be designed with a minimum nominal voltage of 24kV (RMS phase to phase)
- (b) Stay wire 7/4.00 stay wire 1100MPa UTS of 96kN

Stay rod to be 20mm diameter, 2.0m long

Stay plate to be a minimum of 350mm x 350mm x 6mm thick

Stays to be planted at 45 degrees to vertical.

- (c) Factor of safety used on concrete poles is 2.5 as per the OHS Act
- (d) Use the smallest applicable span length
- (e) Electrical clearance span is the phase spacing to prevent electrical clashing
- (f) For transformer poles, use 10m 8kN pole, max weight of transformer 900kg
- (g) Where a line is tied off from another line, fuse protection must be installed on the t-off line (at the point of the t-off)

E20.4.2

Conductor types

Conductor	Type	Diameter (mm)	Weight (kg/m)	Tensile strength (kN)	Strands
Fox	ACSR	8.37	0.149	13.2	7
Mink	ACSR	10.98	0.255	21.8	7
Hare	ACSR	14.16	0.425	36	7

Table 1: Conductor types (ACSR: Aluminium conductor steel core)

The following conductor is preferred:

Aluminium Conductor Steel Reinforced (ACSR) conductor with typical data:

- (a) Equivalent copper area : 64.52 mm²
- (b) Stranding and wire diameter : 6 / 1 / 4.72 mm
- (c) Diameter over steel : 4.72 mm
- (d) Overall diameter : 14.16 mm
- (e) Aluminium area : 104.98 mm²
- (f) Steel area : 17.50 mm²
- (g) Total area : 122.48 mm²
- (h) Approximate cable mass :
 - i. Aluminium : 289 kg / km
 - ii. Steel : 138 kg / km
 - iii. Total : 427 kg / km
- (i) Ultimate tensile strength : 36000 Newton
- (j) Co-Efficient of linear expansion : $19.31 / C \times 10^6$
- (k) Initial modulus of elasticity : 48500 MPa
- (l) Final modulus of elasticity : 80400 MPa

- (m) DC resistance at 20°C : 0.2733 Ω / km
- (n) Current rating : 360 A

E20.4.3 Span lengths, sag and tension

The span length from one structure to the next shall not exceed 100 meters. The design will adhere to the sag and tension characteristics issued by the manufacturer of the conductor.

E20.4.1 Vertical Clearance

All vertical clearance profiles will comply with the Occupational Health and Safety Act (No. 85 of 1993)

Nominal voltage (rms phase to phase)	24	kV
Minimum safety clearance	0.32	m
Above ground	5.5	m
Above roads	6.4	m
To buildings, poles and structures not forming part of power lines	3	m

Table 2: Vertical Clearance profiles

E20.4.2 Excavations

The contractor will satisfy himself of the ground conditions and make provisions for any hard rock in his excavation prices.

The contractor will obtain the distribution standards as listed and in this specification and shall execute the entire project in accordance with these standards.

Soil types can be roughly classified into four groups based on the maximum soil bearing pressure (see table below)

Soil Type	Maximum soil-bearing pressure kPa
Type "A"	300
Type "B"	120
Type "C"	100
Type "D"	50

Table 3: Soil Types

- (a) All soils to be checked by a professional engineer
- (b) All stays in types "A" and "B" soil to have six pockets of cement added to excavated soil, which is then thoroughly mixed and compacted in 200mm layers with an 11kg hand-compactor. All stays for types "A" and "B" soil to be 1.5 x 0.8 x 2.0m deep as a minimum
- (c) All poles in types "A" and "B" soil to have four pockets of cement added to excavated soil, which is then thoroughly mixed and compacted in 200mm layers with an 11kg hand compactor. All pole foundations for types "A" and "B" soil to be 0.7 x 0.7 x planting depth as a minimum

Poles shall be planted at the following depths:

- i. 7m poles 1.3m

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- | | | |
|------|-----------|-------|
| ii. | 9m poles | 1.5m |
| iii. | 11m poles | 1.8m |
| iv. | 12m Poles | 2.0 m |

- (d) For types “C” and “D” soil, the pole foundations and stay sizes must be designed by a professional engineer

E20.4.3 MV Network

The MV network shall be constructed, in general, to the following particular specification

- | | | |
|-----|------------------------|--|
| (a) | Configuration | : Delta, horizontal installed |
| (b) | Nominal Line Voltage | : 24kV (RMS, phase to phase) |
| (c) | Conductor | : Aluminium Conductor Steel Reinforced (ACSR), |
| (d) | Basic Insulation Level | : According to Line Nominal Voltage (11kV: BIL 300kV) |
| (e) | Poles | : As specified (horizontal) |
| (f) | Numbering
number) | : To Eskom requirements (transformer/feeder number with pole |
| (g) | Transformers | : As specified |

E20.4.4 MV power line structures

The following medium voltage structures may be erected as part of this contract:

- (a) MV Single Pole Intermediate (delta).
- (b) MV Single Pole Strain - Vertical (0° - 30°).
- (c) MV Single Pole Strain – Vertical (30° - 90°).
- (d) MV H-Frame In-line Strain – Horizontal For road Crossings.
- (e) MV H-Frame Termination Structure with Drop Out fuse assemblies and Station Class surge arrestors.

The contractor shall be responsible for specifying and supplying all materials required for the complete assembly of all structures. All equipment and components used in the construction of the line shall be rated for the nominal voltage and basic insulation level (BIL).

E20.4.5 Setting out of the Works

The contractor shall include the cost for the setting out of the Works in his bid.

An approved surveyor familiar with the erection of overhead lines, appointed by the contractor, shall capture all the positions of structures on a scaled drawing. The surveyor shall provide his services during negotiations for wayleaves etc. wherever and with whomever the client will need to negotiate.

The survey plan shall include

- (a) Structure angles;
- (b) Span lengths;
- (c) Stay directions;
- (d) Road and railroad crossings with profiles;
- (e) Natural obstacles (rivers, graveyards etc.);
- (f) Roads;
- (g) Existing overhead electrical infrastructure;
- (h) Envisaged use of flying stays.

The survey plan must be approved by the Engineer prior to construction

E20.4.6 Bush clearing

The contractor shall allow for all bush clearing in his pricing, and shall determine the extent of the bush clearing required prior to tendering. The contractor shall adhere to all recommendations as detailed in the environmental scoping document.

E20.4.7 Reinstating of roads and fences

The contractor will be responsible for reinstating and the repair of all damage or changes made to roads and fences during construction.

E20.4.8 Gates

The contractor will install gates to ensure construction vehicle access to servitude land where power lines are erected.

E20.4.9 Earthing

The equipment earthing shall comply with the particular specification E11: Electrical Earthing and Lighting Protection.

The contractor shall appoint a specialist engineer to do all soil resistivity tests, the earthing designs and compliance testing after installation. The earthing design shall be submitted to the client for approval. All test results will be documented and submitted to the client for acceptance.

E20.4.10 Connections to existing infrastructure

The contractor will liaise with the client and obtain a certificate to commence work prior to connecting to any client owned infrastructure.

E20.5 **TESTING**

On completion of the installation, the contractor shall perform all the necessary tests as prescribed by SANS, NRS or IEC as well as performing the manufacturer's routine tests and any other tests that the engineer may require.

In particular, the following tests shall be performed for the overhead line structures

- (a) All type tests as prescribed elsewhere in this document for steel, galvanizing, insulators, poles, structures, conductors, stay assemblies, bolts, nuts and other paraphernalia. Where type tests were performed on similar equipment, test results can be presented at the tender stage;
- (b) Soil bearing pressure tests at each foundation position where reinforced concrete foundations are to be used;
- (c) Soil test where poles are buried to ensure pole stability;
- (d) Pull out tests in all soil conditions for rock anchors for stays and foundations;
- (e) Soil resistivity tests at each structure.

E20.6 **AS-BUILT DRAWINGS**

The contractor will provide a complete set of fully marked up 'As Built' drawings.

The contractor will provide the following as a minimum in a hardbound cover to the Engineer for his approval:

- (a) Dimensioned drawings for the layout of the equipment, structures and systems.
- (b) Wiring diagrams cross referenced to the site drawings
- (c) All test Certificates for both FAT and SAT.
- (d) System and equipment descriptions.
- (e) Operating manuals for all equipment.
- (f) Maintenance manuals of all equipment, including all adjustment and calibration

instructions, fault finding procedures and maintenance schedules.

E20.7 DAMAGE TO PROPERTY

The contractor will take all precautions to prevent damage to property.

Where such damage cannot be avoided, a full report containing the following information will be submitted to the Engineer.

- (a) Name and address of the property owner;
- (b) Nature of the damage;
- (c) Reason why damage cannot be avoided;
- (d) Contractors estimate of compensation.

Construction work shall only be allowed to proceed once approved by the Engineer. The engineer will provide feedback within 14 days.

Accidental damage shall be reported to the Engineer immediately and repaired within 48 hours. All costs associated with the accidental damage shall be for the account of the contractor.

E20.8 MEASUREMENT AND PAYMENT

The tendered rate shall include full compensation for the design, supply, handling, inspection, testing and delivery of the equipment to implement the overhead line. It will also include full compensation for the soil resistivity testing, design, supply, handling, inspection, testing and delivery of the material required for the equipment earthing

<u>Item</u>	<u>Unit</u>
Supply and deliver Overhead Line.....	No

The unit of measurement shall include the total length of the conductors supplied, number of wooden poles, cross members with braces, line insulators, drop-down fuse assemblies and surge arrestors.

<u>Item</u>	<u>Unit</u>
Supply and deliver Earthing system.....	No

The unit of measurement shall include soil resistivity testing, design, supply, handling, inspection, testing and delivery of the material required for the earthing (down conductors, earthing spikes and associated clamps, splices ext.)

<u>Item</u>	<u>Unit</u>
Install, commission and test Overhead Line.....	No

The unit of measurement shall include all excavation works, civil works, crainage and scaffolding, installation of poles, cross members and conductors, testing and commissioning of the overhead line complete with equipment earthing.