Eskom	**Standard** *(Final)*	

Title: **Standard for non-lethal energized perimeter fence structure and associated equipment for the protection of Eskom installations**

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Contents

1 Introduction

The aim of this standard is to prescribe requirements regarding non-lethal energized fences that Eskom and its subsidiaries must apply with regard to protecting its installations. This standard must be used by the Divisions of Eskom and its subsidiaries to structure (or restructure) their non-lethal perimeter fence with the ultimate aim of a uniform set of measures being applied in Eskom.

The purpose for using a non-lethal energized perimeter fence is not only detection, but also deterrence, in order to maximize the protective value.

The highest legal energy must be supplied to the fence and best available and applicable conductor used at specific site, so as to ensure that energy drop along the fence is reduced to an absolute minimum.

2 Document Content

2.1 Requirements

2.1.1 Application

a) At National Key Point installations, the non-lethal energized perimeter fence must be self-supported, installed between electrically inert (inner and outer), double barrier perimeter fence system.

b) At other sites, when installed along a public road, or in an urban area, it is preferable that the non-lethal energized perimeter fence be self-supported, erected inside the outer barrier perimeter fence as applicable, but installed in such a manner that persons cannot inadvertently come into contact therewith.

c) The height of the non-lethal energized perimeter fence and spacing of supports shall be as specified (Refer to Annex D).

d) Should any services transverse any of the above mentioned fences, proposals must be submitted to Eskom during the tender process, for adequate protection against possible intrusion, if and when required.

2.2 Principle of Operation

2.2.1 OHS Act

a) The energized perimeter fence system shall in all aspects conform to the Occupational Health and Safety Act Regulations (OHS Act No. 85 of 1993 - dated April 2003) or latest revision - Electrical Machinery Regulation – item 11 - Electric Fences. These regulations were first published in GNR 1593 of 12 August 1988 and subsequently amended by GNR 1185 of June 1990.

2.3 Earthing

Note: to be read in conjunction with sub-section 2.8.7

The purpose of the earthing for the energized perimeter fence is two-fold.

a) Firstly, would be to decrease the resistance of the soil. This means that if the soil is dry, its electrical resistance is high. When earth pegs are used at regular intervals of 10 to 20m in the case of dry soils, 20 to 50m in case of semi-moist soils and 50 to 100m in the case of moist soils (refer to Annex B), the resistance will decrease. The purpose of the non- lethal energized perimeter fence system is eventually to deliver impulses of electrical energy in accordance with Occupational Health and Safety Act No 6 of 1993, even if the would-be intruder does not touch a ground wire. For this reason the soil resistance must be as low as possible.

b) Secondly, would be to protect the energizer against damage caused by lightning as referred to in section 2.4 below, whilst taking into consideration that it is impossible to handle the total energy of a direct hit.

2.4 Lightning Protection

a) The equipment will be installed where it will be subject to voltage surges due to lightning, line faults, power interruptions, high voltage switching conditions, and must be able to operate without failure under these conditions. Therefore, it is imperative that the system be adequately earthed.

b) Protection against high voltage transients shall be provided on both signal and power circuitry, without impairing the system's electrical parameters, sensitivity, or performance.

2.5 Quality Assurance

a) The Contractor shall be responsible for the provision of all services associated with the concept and implementation of a programme for the quality assurance control.

b) This programme shall be agreed with Eskom.

2.6 Documentation / Drawings / Wiring Diagrams

a) One (1) draft copy of the (Operating, Training and Maintenance/Spares) manuals must be supplied to Eskom for approval at time of tender submission and three (3) final copies of the approved manuals and as built drawings and wiring diagrams must be supplied at time of commissioning.

b) Factory acceptance tests for the energizers are required and must take place at the Contractor's factory / assembly plant prior to delivery of the energizers to Eskom site.

2.7 Security

a) All persons required to work on the project shall be made known to Eskom in writing, one (1) week after contract award.

b) Access procedure shall be specific to the site.

2.8 Fence Structure

2.8.1 Free Standing

a) A free standing energized perimeter fence structure must be erected at a minimum of two (2) meters away from the outer barrier perimeter fence.

b) SANS 10222-3:2003 will be used as a general guideline for installation of the energized perimeter fence structure.

2.8.1.1 Strain posts, and struts complete with all bolts, insulators and concrete foundations

a) Strain posts must be manufactured from 60mm x 60mm x 6mm RSA, 3000mm long with 2 (two) strut brackets welded in position to accept the strut fixings.

b) Strain posts must have 24 (twenty four) holes in one flange, 100mm apart to accept the strain insulators, and have installed non metallic tensioner for each wire in one direction.

c) Strain posts must have 2(two) struts manufactured from 60mm x 60mm x 6mm RSA 2200mm and 3700mm long.

d) Each strut must have a hole at one end to allow for fixing to the strain post.

e) Strain posts and struts must be hot dipped galvanized and fitted complete with 24 (twenty four) strain insulators, 24 (twenty four) non-metallic tensioners, and 2 (two) x M10 x 25 galvanized bolts, nuts and washers.

f) Strain posts must have 500mm x 500mm x 600mm deep, 20MPA concrete foundations.

g) Struts must have 500mm x 500mm x 300mm deep, 20MPA concrete foundations.

h) Maximum distance between (2) two consecutive strain posts must not exceed 80m.

2.8.1.2 In-Line strain posts (0-15ºangle) and struts complete with all bolts, insulators and concrete foundations

a) In-line strain posts (0-15ºangle) must be manufactured from 60mm x 60mm x 6mm RSA, 3000mm long with 2 (two) strut brackets welded in position to accept the strut fixings.

b) In-line strain posts (0-15ºangle) must have 24 (twenty four) holes in one flange, 100mm apart to accept the strain insulators, and 24(twenty four) non metallic tensioners for each wire in each direction.

c) In-line strain posts (0-15ºangle) must have 2 (two) struts manufactured from 60mm x 60mm x 6mm RSA 3500mm long each.

d) Each strut must have a hole at one end to allow for fixing to the in-line strain (0-15ºangle) post.

e) In-line strain posts (0-15ºangle) and struts must be hot dipped galvanized and fitted complete with 48 (forty eight) strain insulators 48 (forty eight) non-metallic tensioners and 2 (two) x M10 x 25 galvanized bolts, nuts and washers.

f) In-line (0-15ºangle) strain posts must have 500mm x 500mm x 600mm deep, 20MPA concrete foundations

g) Struts must have 500mm x 500mm x 300mm deep, 20MPA concrete foundations.

h) Maximum distance between 2 (two) consecutive in-line (0-15ºangle) strain posts must not exceed 80m.

2.8.1.3 In-Line strain posts (15-75º angle) and struts complete with all bolts, insulators and concrete foundations

- In-line strain posts (15-75º angle) must be made up from two strain posts installed back-to-back.
- In-line strain posts (15-75º angle) must be manufactured from 60x60x6mm RSA, 300mm long with 2(two) strut brackets welded in position to accept the strut fixings.
- In-line strain posts (15-75º angle) must have 24(twenty four) holes in one flange, 100mm apart to accept the strain insulators, and non metallic tensioners for each wire in one direction.
- In-line strain posts (15-75º angle) must have 2(two) struts manufactured from 60x60x6mm RSA 2200mm and 2(two) struts of 3700mm long.
- Each strut must have a hole at one end to allow for fixing to the in-line strain posts (15-75º angle).
- In-line strain posts (15-75º angle) and struts must be hot dipped galvanized and fitted complete with 24(twenty four) strain insulators, 24(twenty four) non-metallic tensioners and 2(two) M10x25 galvanised bolts, nuts and washers.
- In-line strain posts (15-75º angle) must have 500x500x600mm deep, 20MPA concrete foundations.
- Struts must have 500x500x300mm deep 20MPA concrete foundations.
- Maximum distance between 2 (two) consecutive in-line strain posts (15-75º angle) must not exceed 80m.

2.8.1.4 Corner strain posts and strut complete with all bolts, insulators and concrete foundations

a) Corner strain posts must be manufactured from 60x60x6mm RSA, 300mm long with 2(two) strut brackets welded in position to accept the strut fixings.

b) Corner strain posts must have 24(twenty four) holes in each flange, 100mm apart to accept the strain insulators, and non metallic tensioners for each wire in one direction.

c) Corner strain posts must have 4(four) struts manufactured from 60x60x6mm RSA, 2(two) of 2200mm and 2(two) of 3700mm long.

d) Each strut must have a hole at one end to allow for fixing to the corner strain post.

e) Corner strain posts and struts must be hot dipped galvanized and fitted complete with 48(forty eight) strain insulators, 48(forty eight) non-metallic tensioners and 4(four) M10x25 galvanized bolts, nuts and washers.

f) Corner Strain posts must have 500x500x600mm deep, 20MPA concrete foundations.

g) Struts must have 500x500x300mm deep 20MPA concrete foundations.

2.8.1.5 Intermediate posts including all bolts, insulators and concrete foundations.

a) The intermediate posts must be manufactured from 40mm x 40mm x 3mm RSA, 3000mm long.

b) The intermediate posts have 24 (twenty four) holes on one flange, 100mm apart, to accept the intermediate insulators.

c) Intermediate posts have a 300mm x 300mm x 300mm deep 20MPA concrete foundation.

d) The maximum distance between two (2) consecutive intermediate posts must not exceed 5m.

2.8.2 Motorised Barrier Gates

- A minimum of 23 (twenty three) conductors must be strung on insulators, fixed on 60mm x 60mm x 6mm RSA posts, stayed and bolted on the existing 6,0m double leaf barrier gates. Minimum length of posts must be 3,00m.
- Installed and wire approved heavy duty 220V AC motor mechanism to operate one leaf of barrier gate.
- Fit special lockable drop-bolt and keep to other leaf of gate. Bolt to be bolted to gate frame.
- Additional keeps to be provided for gate in open position. Bolt must be 20mm diameter, 600mm long mild steel fully galvanized. Keeps must be 25mm O/D galvanized pipe, 150mm long cast in concrete.
- Motor enclosure to be concreted in or above ground, to supplier specification. Motor housing, crank and fittings must be fully galvanized. Cable entry points to housing must have water-tight fittings.
- Tenderer to state supplier. Only Eskom approved motors will be accepted.

2.8.3 Concrete anti-tunnelling T beam

a) The re-inforced concrete anti-tunnelling T-Beam, must be situated directly underneath the energized perimeter fence.

b) Trench 100mm wide x 500mm deep (maximum) under the energized fence line. Where hard rock is encountered excavation must stop. Excavated material must be spread in barrier fence servitude.

c) Install 100mm x 100mm x 3mm steel mesh x 500mm (ref 156) wide in centre of trench. Allow 100mm to protrude above ground level, which must be bent over 30mm above ground level, used to attach slab reinforcement and cast in with the surface slab.

d) Fill trenches with 20MPA vibrated mass concrete.

2.8.4 Vegetation control concrete slab

a) Cast 20MPA concrete slab, 800mm wide. Bottom of slab must be levelled with surrounding ground level. The beam must be in the centre of the concrete slab.

b) 100mm x 100mm x 3mm steel mesh (ref 156) x 600mm wide, must be laid 75mm above ground level, 300mm on each side of the beam, cast with vibrated concrete to form the slab.

c) Slab to be poured on graded compacted ground and must constantly fall between posts.

d) The distance between the slab and the bottom conductor / trace wire must not exceed 100mm.

e) Slab must be cast in such a way, that conductors / trace wires are always in the centre of the slab.

f) Sides and top of the concrete slabs must be smooth wood shutter finish.

g) Panel sizes must be 800mm wide x 3000mm long x 75mm thick at the sides, 150mm centre and cast in alternative sections.

h) All joints must be butted.

i) 800mm x 150mm x 10mm wide soft board expansion joints must be provided at a maximum of 3,0m centres.

2.8.4 Conductor Wires, HT Cables, Insulators and Ferrules

2.8.4.1 Conductor Wires

All conductor wires must be manufactured from aluminium 1,6mm, as it has a very good corrosion resistance by building up its own protection with an oxide layer, and in addition has a very low electrical resistance (33Ω/km) see Annex C, resulting in optimum energy availability with a maximum deterrence effect, along the energized perimeter fence, together with the highest degree of resistance to all inclement weather / atmospheric conditions.

The aluminium conductor wires must be pulled in position with a maximum force not exceeding 25Kg.

2.8.4.2 High Tension (HT) Cables

HT cables must be used to connect the energizer output connectors to the 1,6mm conductor wires of the energized perimeter fence. The inner core of the HT cables must be of the same material composition as the 1,6mm aluminium conductor wires. The HT cables must be mounted inside a 32mm conduit. This will facilitate future repairs and protect the cables.

2.8.4.3 Insulators

All strain and intermediate insulators must conform to the following requirements:

a) Guaranteed UV protection for a minimum period of 5 (five) years.

b) The design of a (V) shaped split ring insulator must ensure easy insertion of the conductor/trace wire, and experience difficulty when trying to lift the conductor/trace wire from the split-ring insulator. Sample of proposed split-ring insulator must be submitted together with 1m of conductor/trace wire for approval by Eskom.

c) Tested to withstand a minimum arcing voltage of 20kV when applied between the mounting screw and the 1,6mm aluminium conductor wire. During the test, insulators must be soaked with a 2 % saline solution, in order to simulate coastal conditions. No arcing may occur during the test.

d) Strain insulators when fastened to a fixed point with its standard attachment screw, must withstand a pulling force of 300kg at 45 °C when applied to a 2,24mm steel wire attached to the insulator.

2.8.4.4 Ferrules

Ferrules must be used to inter-connect fence conductor wires and HT cables, and must be manufactured from the same material composition as the 1,6mm aluminium conductor/trace wires.

2.8.5 Warning Signs

a) UV resistant warning signs of minimum size (200mm x 100mm) must be displayed conspicuously, warning people that the site is protected by an electric fence, and securely fixed along the entire length of the energized perimeter fence, at each gate and access point, placed on the last (top) conductor / trace wire and spaced at intervals not exceeding 10m.

b) Warning signs must comply with IEC 60335-2-76.

c) Background colour of each warning sign must be yellow with black inscription.

2.8.6 Energizer

The specification of the energizer will be in accordance with IEC 60335-2-76 International Standard:

a) Peak value of voltage must be above 8kV, but not exceeding 10kV

b) Maximum energy delivered to a load of 500Ω must not be less than 7,5 Joule. Minimum interval between impulses should not be less than 1,0 s

c) Maximum impulse duration must be 50ms

d) The number and configuration of the conductor / trace wires must be as follows:

Energizers	Conductors	Live Conductors	FB1	FB2	FB3	FB4
1	24	11	11			
2	24	12	5	7		
3	24	11	3	3	5	
4	24	12	3	3	3	3

When using more than four (4) energizers, the energized perimeter fence must:

- Be divided into two sectors and
- Energized from both ends
- Conductor / trace wire configuration remains as above
- When twelve (12) energizers are used, one (1) conductor / trace wire can be used per energizer

All energizers must be synchronized in order to be regarded as one energizer with multiple outputs, all firing at the same time, as one single pulse.

In order to provide optimum protection against lightning, all energizers must be installed in a dedicated lockable room inside the access control building. No energizers must be installed in the field, in huts or outside panels along the perimeter fence.

The energizer must have its own stand-by DC power and be programmable for up to 20 zones.

2.8.7 Earthing (to be read in conjunction with section 2.5 above)

a) 35mm² copper earth rods must be laid in trenches around the complete perimeter, and must be linked back to the main earth mat. Refer to drawing No 0.03/12156 Rev 2, or latest revision.

b) All fence posts, must be connected to the ring main with 35mm² earth rods. Refer to Earthing Standards drawing No 0.54/393.

c) All light posts earth to be connected to this ring main with 6mm² stranded copper.

d) All joints to be braised/crimped to Eskom's approval. Joint laps to be 75mm.

e) All other electrical cabinets to be earthed with 6mm² stranded copper to earth rod and / or graded earth mat.

f) Earth pegs must be used at the beginning or end of each zone, at a maximum distance of 50m apart. Earth pegs must be connected to the main earth rod, the fence posts and earth conductors of the fence.

g) Three (3) earth pegs, 1,8m apart in a triangle layout, must be installed at both sides of the Access Control Building (ACB). The pegs must be connected to the main earth rod and the first post on each side of the fence.

h) Earth pegs must be 1,5m in length and be copper coated.

i) On both sides of the ACB, connect all earth pegs, lightning diverter and energizer ground connections together with 16mm² copper earth cable.

j) A 16mm² copper earth cable from the energizer to the earth pegs must be laid on both sides of the ACB.

2.8.8 Positioning of HT Cables

a) Excavate cable trenches where required, and lay HT cables.

b) Trenches will be 300mm wide and vary in depth between 300 and 1000mm.

c) Danger tape will be laid in trenches 300mm above conductors, before back-filling and compacting.

d) All cables fixed to fence or structures shall be secured with aluminium cable ties.

e) All HT cables terminated on fence shall be securely fixed at 2 points before terminating and sealing with “Denzo” tape.

f) All bolts shall be treated with “Lock-tight”.

g) All cables for equipment located outside the access control building and on the gates shall be adequately protected against vandalism.

h) All conductors leaving ground level shall be in GI pipe sleeves for a height of at least 300mm above ground level.

i) Installation to be done in such a manner as to prevent moisture from entering GI pipe sleeves and conduits.

2.8.9 General

a) All steel components, unless otherwise specified, will be hot dipped galvanised to meet SABS 764 specification after completion of fabrication. Certificate of compliance with SABS 764 specification must be submitted to site supervisor for inspection and acceptance of material delivered to site.

b) No cutting, drilling, or welding will be performed on steel after galvanising.

c) Should minor operations, on galvanised material be necessary, the steel portion requiring such rectification must be treated with an Eskom’s approved, high zinc content paint.

d) Tenderer to provide drawings of all items required in the order, for Eskom’s approval.

e) Method of fixing insulators to all posts, must be approved by Eskom.

f) All bolts will be fully galvanised, length to suit application, fitted with galvanised washers and nuts.

g) Cadmium or electro-plated material is not acceptable.

h) Intermediates will be spaced at a maximum of 5,0m with inline strain posts at a maximum of 80m centres.

i) Only Eskom approved insulators will be accepted and may be either inorganic materials, or chemical compound which must be UV stabilized.

j) Leakage current, electrical strength, moisture resistance, creep-age and flashover distances must be stated.

k) Method of fixing to posts and configuration must be to suit post application.

l) All looping of conductors shall be carried out, and fence shall be tested for electrical continuity to insure that all conductors are continuous.

m) Where looping is required, conductor and looping materials must be compatible.

n) Looping at change of direction, corner and strain posts must be on the attack side of the fence.

o) Joining of conductors must be achieved through the use of Aluminium ferrules manufactured from the same material composition as the 1,6mm Aluminium conductor. (Alloy 5019 Heat No: M9067)

p) A pre-detection system such as (Anti-Climbing, CCTV, Seismic or Optical) would be required on the inner side of the outer barrier perimeter fence, for integration into the energized perimeter fence system, and if required sectors must be synchronized with the perimeter security lighting system.

q) All aluminium ferrules must be wrapped with “Denzo” tape in order to minimize the occurrence of dry joints. The use of pre-insulated crimping tool model number YYP1 to crimp aluminium ferrules is recommended.

3 Supporting Clauses

Index of Supporting Clauses

3.1 Scope

This standard sets out Eskom’s technical and functional requirements for a non-lethal energized perimeter fence structure and associated equipment for the protection of Eskom installations.

3.1.1 Purpose

This standard is a technical document that specifies functional, performance and other requirements, equipment and materials should meet to satisfy the needs for high quality non-lethal energized perimeter fence system for the protection of Eskom installations.

3.1.2 Applicability

This standard shall apply throughout Eskom Holdings Limited, its divisions, subsidiaries and entities wherein Eskom has a controlling interest.

3.2 Normative/Informative References

3.2.1 Normative

TRMSCAAY9: Specification for non lethal electrified fence structures and associated equipment for Transmission sites

3.2.2 Informative

South African Bureau of Standards (SABS)

SABS 1222: Protection of Enclosures

SABS 1200: Standardised specifications for Civil Engineering Construction

SABS ISO 1461: Hot-dipped galvanized coatings

SABS 1507: Dielectric insulation for fixed installations

SANS 10222-3:2003

SABS 764

IES Documents, Codes and Reference Documents

IES 60335-2-76 Part 2-76: Particular requirements for electric fence energizers

OHS Act Occupational Health and Safety Act No 6 of 1993

Government Regulation R 1593

IEEE Std 80-2000 (Revision of IEEE Std 80-1986) Guide for Safety in AC Substation Grounding

Eskom Drawings

0.52/1191: Control and Power Wiring Terminations

0.00/5007: Labels

0.54/393: Earthing Standards

Note: NB where equivalent National or IEC specifications exist, they may be acceptable, subject to approval by Eskom. Request for approval must be applied for in writing.

3.3 Definitions

All definitions appropriate to the document have been listed next to the abbreviations.

3.4 Abbreviations

3.4.1 SABS: South African Bureau of Standards

3.4.2 NB: Nota Bene (take notice)

3.4.3 RSA: Republic of South Africa

3.4.4 mm: millimetre

3.4.5 m: Metre

3.4.6 UV: Ultra Violet

3.4.7 kV: kilovolt

3.4.8 MPA: Mega Pascal

3.4.9 Ref: Reference

3.4.10 HT (cables): High Tension

3.4.11 Ω/km: Ohms per kilometre

3.4.12 km: kilometres

3.4.13 Kg: Kilogram

3.4.14 C: degrees Celsius

3.4.15 s: second

3.4.16 ms: mild steel

3.4.17 DC: Direct Current

3.4.18 Ref: reference

3.4.19 GI: Galvanized Iron

3.4.20 CCTV: Close Circuit Television

3.4.21 kN: kilo Newton

3.4.22 O/D: Outside Diameter

3.5 Roles and Responsibilities

Procurement officials must refer to this standard in their purchasing documents and require that equipment and material offered for purchase, meet the requirements.

Compliance with the requirements of this standard must be guaranteed by the vendor.

3.6 Implementation Date

The implementation date is 1st August 2008

3.7 Process for monitoring

See paragraph 2.5 Quality Assurance

3.8 Related Documents

See paragraph 2.6 Documentation

4 Authorisation

This document has been seen and accepted by:

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PJ Maroga	Chief Executive
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5 Revisions

Date	Rev.	Remarks
November 2007	0	Compile document
November 2007	0	EDC ISO formatted and checked
February 2008	0	EDC ISO reformatted

6 Development member

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Annex A
(informative)

Size of Concrete Foundations

Minimum strength of concrete must be 20 MPA

	Type 1 Soils	**Type 2** Soils	**Type 3** Soils
Strain Posts	500x500x600mm Deep	500x500x600mm Deep	700x700x600mm Deep
In Line	500x500x600mm Deep	500x500x600mm Deep	700x700x600mm Deep Strain Posts
Angle/Corner	600x600x600mm Deep	600x600x600mm Deep	800x800x600mm Deep Posts
Intermediate	300x300x300mm Deep	300x300x300mm Deep	300x300x300mm Deep Posts
Struts	500x500x300mm Deep	500x500x300mm Deep	500x500x500mm Deep

- **Type "1" soils:** Competent soil with equal or better consistency (strength or toughness) than one would encounter in stiff cohesive soils, or dense cohesion-less soils above the water table. This soil must have a broad balanced texture (constituent particle sizes) with high average combination of un-drained shear strength and internal angle of friction, with minimum values of 80 kN/m² and 30 º respectively. The minimum natural specific weight shall not be less than 18 kN/m³.
- **Type "2" soils:** A less competent soil than type "1", with equal or weaker consistency than one would encounter in firm to stiff swelling cohesive soils, or dry poorly graded loose to medium dense cohesion-less soils above the water table. The minimum un-drained shear strength shall be 40 kN/m², and the minimum natural specific weight shall not be less than 16 kN/m³.
- **Type "3" soils:** Dry loose cohesion-less soil, or very soft to soft cohesive soil.

Annex B
(informative)

Soil Composition

B.1 Although no two soils are alike, there are roughly six (6) main soil composition types:

Clay, Sandy, Silty, Peaty, Chalky and Loamy. Soils are usually a combination of these ingredients in varying quantities.

B.1.1 Sandy Soils

Sandy soils have a gritty texture and are formed from weathered rocks such as limestone, quartz, granite and shale. If sandy soil contains enough organic matter it is prone to over-draining and dehydration in warm weather. In wet weather it can have problems retaining moisture.

B.1.2 Silty Soils

Silty soils are usually composed of minerals (predominantly quartz) and offers good drainage. When dry, it has rather a smooth texture and looks like dark sand. Its weak soil structure means that it is easy to work with when moist and it holds moisture well.

B.1.3 Clay Soils

When clay soils are wet they are very sticky, lumpy and pliable but when they dry, they form rock-hard clots. Clay soils are composed of very fine particles with few air spaces, thus they are hard to work and often drain poorly – they are also prone to water logging. Red colour in clay soil indicates good aeration and a “loose” soil that drains well.

B.1.4 Loamy Soils

Considered to be the perfect soil, loamy soils are a combination of roughly 40 % sand, 40 % silt and 20 % clay. Loamy soils can range from easily workable soils, to densely packed sod. Characteristically they drain well, yet retain moisture.

B.1.5 Peaty Soils

Peaty soils contain more organic material than other soils because their acidity inhibits the process of decomposition. This type of soils is prone to over-retaining water.

B.1.6 Chalky Soils

Chalky soils are alkaline, usually light-brown in colour, and contain large quantities of stones of varying sizes. They dry out quickly in warm weather.

Annex C
(informative)

Conductor/Trace Wire Resistance

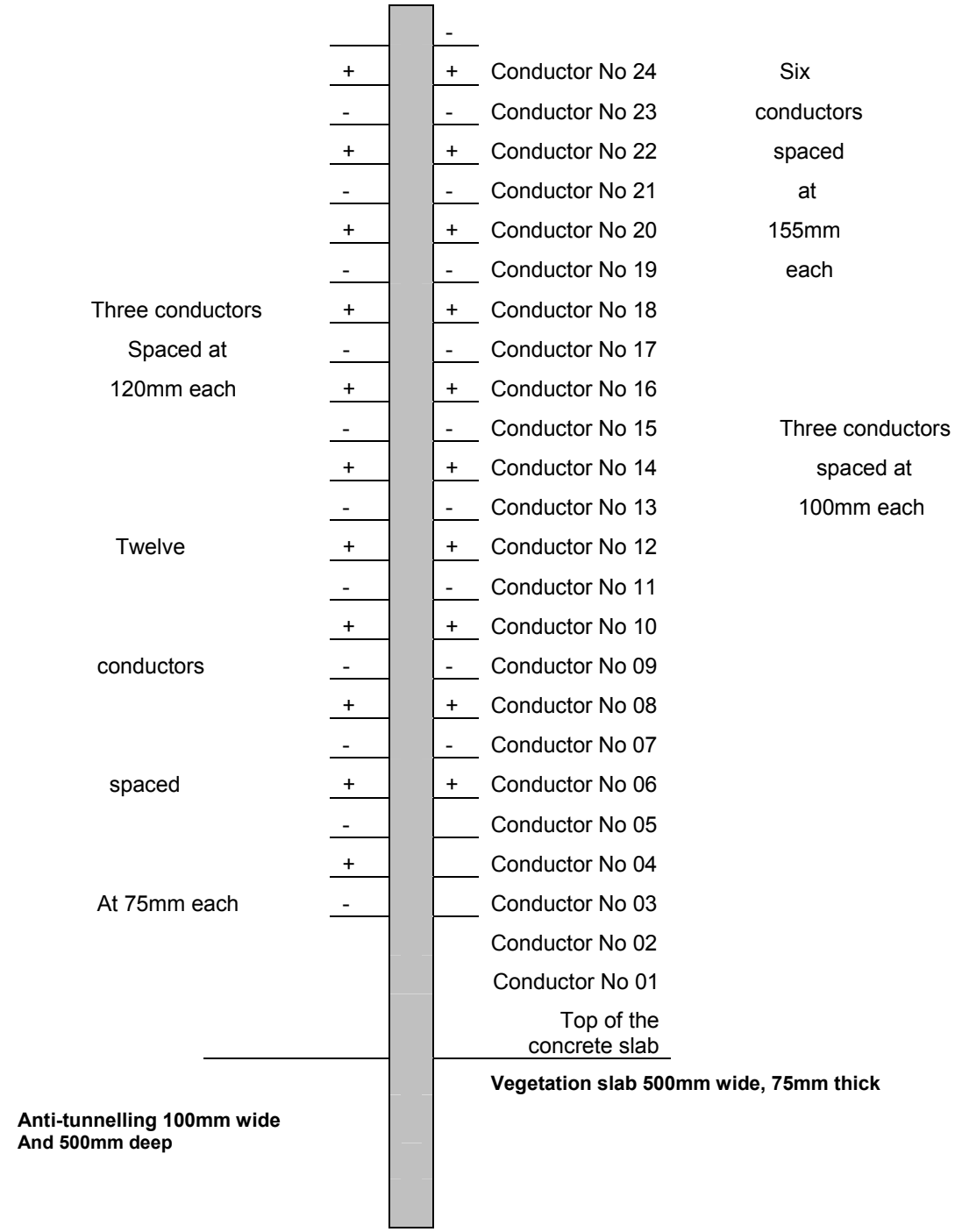
Type of Conductor/Trace Wire	Resistance (Ω/Km)	Max Tolerable Live Wire Length	L 1/2V)
Stainless 1,2mm	770	2 Km	650m
Braided 1mm	330	5 Km	1,6Km
Braided 1,3mm	260	5,7 Km	1,9Km
Gal. Steel 1,57mm	100	15 Km	5Km
Braided SS/Copper	80	18 Km	6Km
Gal. Steel 2,24mm	50	30 Km (taken at 25 Km)	10Km
Aluminium wire 1,6mm	33	150 Km	50Km

The value L (1/2V) is that length of live conductor/trace wire, where half of the energizer output voltage drops across it, and the other half across a would be intruder coming into contact with the conductor/trace wire. This value relates to any energizer being used.

The resistance of a human body is standardized at 500 Ω

Annex D
(normative)

HV Aluminium Conductor Polarity & Trace Wire Spacing



NB: Total height of pole is 3.0m