

 <b>Eskom</b>	<b>Standard</b>	<b>Technology</b>
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Title: **STANDARD FOR OPERATIONAL FLOODLIGHTING IN TRANSMISSION SUBSTATIONS** Unique Identifier: **240-83382076**

Alternative Reference Number: **N/A**

Area of Applicability: **Engineering**

Documentation Type: **Standard**

Revision: **2**

Total Pages: **16**

Next Review Date: **April 2026**

Disclosure Classification: **Controlled Disclosure**

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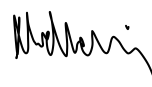


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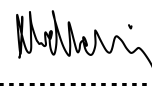


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## **1. Introduction**

Operational Floodlighting is used throughout Eskom Substations. The purpose of Floodlighting is for personnel to observe obstructions & other hazards while moving within the high voltage yards at night time, and to read high voltage apparatus identification labels, mounted at heights not exceeding 2m above the ground level.

## **2. Supporting clauses**

### **2.1 Scope**

This specification sets out Eskom Transmission's requirements for the supply, delivery, installation, testing and commissioning of Floodlighting installations.

#### **2.1.1 Purpose**

This document specifies the technical requirements for the operational Floodlighting used in Eskom Transmission substations. And it will be used for tender enquiry.

#### **2.1.2 Applicability**

This document shall apply throughout Eskom Transmission Substations, subsidiaries and entities wherein Eskom has a controlling interest.

## **2.2 Normative/informative references**

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

Suppliers are responsible for obtaining the latest copies of the South African national standards (SANS) and international standards referred to in this document. Copies of the latest revision of Eskom documents will be supplied by the purchaser and will form part of the enquiry documentation.

### **2.2.1 Normative**

- [1] ISO 9001 Quality Management Systems.
- [2] SANS 121:2000: Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods.
- [3] SANS 156:2007: Moulded-case circuit breakers.
- [4] SANS 791:2004: Unplasticized poly(vinyl chloride) (PVC-U) sewer and drain pipes and pipe fittings.
- [5] SANS 1091:2004: National colour standard.
- [6] SANS 1186-1:2007: Standard signs and general requirements.
- [7] SANS 1195:2007: Bus bars.
- [8] SANS 1200 – DB: Standardized specification for civil engineering construction Section DB: Earthworks (pipe trenches).
- [9] SANS 1200 – LC: Standardized specification for civil engineering construction Section LC: Cable ducts
- [10] SANS 1250: Capacitors for use with fluorescent and other discharge lamp ballasts
- [11] SANS 1266:2007: Ballasts for discharge lamps.
- [12] SANS 1507:2007: Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V).
- [13] SANS 10142-1: The wiring of premises – Part 1: Low-voltage installations.

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- [14] SANS 10198: The selection, handling and installation of electric power cables of rating not exceeding 33kV.
- [15] SANS 60529: Degrees of protection provided by enclosures (IP Code)
- [16] SANS 60598: Luminaires.
- [17] SANS 62262:2004: Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code).

### 2.2.2 Informative

None

## 2.3 Definitions

### 2.3.1 General

Definition	Description
<b>Ballast</b>	Unit inserted between the supply and one or more discharge lamps which by means of inductance, capacitance or resistance, single or in combination, serves mainly to limit the current of the lamp(s) to the required value
<b>Equipment</b>	Assemblies of components, sub-units or sub-assemblies usually contained in a suitable enclosure, and capable of performing an overall specified function.
<b>Label</b>	An inscription on equipment or on a sub-unit, either integral therewith or on a separate piece of material affixed thereto
<b>Luminaire</b>	Apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes all the parts necessary for supporting, fixing and protecting the lamps, but not the lamps themselves, and where necessary circuit auxiliaries together with the means for connecting them to the supply.
<b>Reliability</b>	The ability to consistently function as specified under stated conditions for a stated time.
<b>Terminal</b>	A metallic device for connecting electrical conductors.

### 2.3.2 Disclosure classification

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

## 2.4 Abbreviations

Abbreviation	Description
<b>AC</b>	Alternating Current
<b>HPS</b>	High pressure sodium
<b>HV</b>	High Voltage
<b>Hz</b>	Hertz
<b>kA</b>	kiloAmpere
<b>LED</b>	Light emitting diode
<b>LV</b>	Low Voltage
<b>mm</b>	millimeter

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Abbreviation	Description
PVC-U	Unplasticized polyvinyl chloride
UV	Ultraviolet
V	Volt
W	Watt

## **2.5 Roles and responsibilities**

Substation Designers, and Project managers who are involved in the designing and installation of Floodlighting shall adhere to this standard when going out on tender.

## **2.6 Process for monitoring**

Not applicable.

## **2.7 Related/supporting documents**

Not applicable.

# **3. Requirements**

## **3.1 Contractor's scope of work**

- a) The contractor shall supply, deliver, off-load, install, test, commission, hand-over and maintain three months free maintenance of all material and equipment specified or implied in this document and on the drawings for the complete LV cable reticulation and miscellaneous works for the floodlight installation.
- b) The contractor shall maintain the installed floodlighting system for free for a period of three months from date of hand-over.

## **3.2 Floodlighting requirements**

### **3.2.1 Illumination levels**

- a) The illumination levels for any substation shall be according to the OHS-act (Revised 11<sup>th</sup> Edition)
- b) The Floodlighting installation shall provide a minimum average illumination level of 10 lux with in the high voltage yard and 20 lux at the transformer bays and reactor bays, with a uniformity ratio of 5 within the high voltage yard being considered.
- c) The illumination level shall be sufficient for personnel to observe obstructions & other hazards while moving within the high voltage yards, and to read high voltage apparatus identification labels, mounted at heights not exceeding 2m above the ground level.
- d) The Floodlighting installation shall not be provided for detailed inspection and/or maintenance work within the high voltage yards. For this purpose Portable Maintenance Lighting shall be required with an illumination level in excess of 50 lux directed at the apparatus on which this work is to be carried out.
- e) To ensure the safety of maintenance personnel, the Floodlighting installations shall be mounted on high masts having a maintenance platform and caged ladder.

### **3.3 Technical requirements of the floodlight installation**

Nominal voltage	: 400/230V
Number of phases	: 3
Number of wires	: 4
System frequency	: 50 Hz
Type of cable	: Insulated Cable
Fault current	: 10 kA at AC Main Board
	: 5 kA at Floodlighting Board
	: 5 kA at Mast Termination Boards

### **3.4 Floodlighting mast plinths**

The contractor shall supply, deliver, install and commission all new floodlighting mast plinths for the mast heights as indicated on cable route and mast location layout drawing.

### **3.5 Floodlighting mast**

- a) The contractor shall supply, deliver and install all new floodlighting masts as indicated on cable route and mast location layout drawing.
- b) The floodlighting mast shall be provided with the following:
  - 1) Access caged ladder
  - 2) Platform with trapdoor,
  - 3) Lockable door at mast base for access to mast termination board.
  - 4) Mounting rails suitable for fixing luminaire brackets on platform.
  - 5) Welded brackets with bolts and earth stud within the base of each mast for the fixing and earthing of mast termination boards.
  - 6) Mounting bracket on each mast platform for attaching the mast junction box.
  - 7) Cable entry point at the top of each mast beneath the platform.
  - 8) All Mast steelwork, hold-down bolts, nuts and washers shall have a hot-dip galvanized zinc coating in accordance with SANS 121.

### **3.6 Point of supply**

The floodlighting distribution board, located inside the control building, shall be supplied from the main AC board as indicated on the 400/230 V AC schematic and Cable block diagram.

### **3.7 Low voltage armoured cable and terminations**

The contractor shall supply, install, terminate and connect all LV armoured cables including cable pipes, excavation and back filling where cables are buried underground.

#### **3.7.1 Cable technical requirements**

- a) PVC sheathed
- b) Single-wire armoured
- c) PVC served
- d) 1000 V general purpose grade
- e) Copper conductors in accordance with the requirements of SANS 1507.

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### **3.7.2 Cable Routing**

#### **3.7.2.1 Control building**

- a) The cables shall be routed in existing cable trenches, on existing horizontal cable racking, next to the existing cables.
- b) The contractor shall arrange with the site manager for the exact location of cables.

#### **3.7.2.2 Substation yard**

- a) The cables shall be installed at the bottom of existing cable trenches, next to the existing cables.
- b) Where the cables must exit the existing cable trenches into open excavations, the cables shall pass below the existing cable trench wall foundation.
- c) Where required existing cable trench covers shall be removed and after the installation of the cables these covers shall be replaced in the original position.
- d) The contractor shall be liable to any damage caused to the trench and/or trench covers and the damages shall be repaired at the contractor's cost.

#### **3.7.2.3 Cable pipes**

At the mast and in any additional cable pipes where it crosses with existing installations if required.

#### **3.7.2.4 Masts**

The cable shall be installed from the mast termination board near the bottom of the mast to the junction box on the mast platform.

### **3.7.3 Cable terminations**

"Pratley" or equal cable glands shall be used for all reticulation cable terminations.

### **3.7.4 Cable junction boxes in trenches**

- a) "Pratley Ezee-fit" or equal cable boxes shall be used where indicated on drawing.
- b) Cable junction boxes in cable trenches shall have a rating of IP68 in accordance with SANS 60529.

## **3.8 Cable sleeve pipes**

- a) Cable sleeve pipes shall only be used where required.
- b) Cable sleeve pipes shall be of heavy duty class, PVC-U with 110 mm outside diameter, in accordance with SANS 791.

## **3.9 Depth of cable**

All low voltage cables outside cable trenches shall be laid at a depth of 500 mm below terrace level.

## **3.10 Cable route indicators**

### **3.10.1 Cable route markers**

- a) Cable route markers shall be provided by the contractor at all points where the cable routes deviate from the existing cable trenches.
- b) The positioning of cable route markers shall be established with the site manager.



### **3.10.2 Marker tape**

- a) Yellow PVC marker tape shall be provided by the contractor and laid directly above all cables that run outside the existing cable trenches.
- b) The marker tape shall be laid at a depth of 300mm below terrace level.

### **3.10.3 Cable number tags**

- a) Cable tags shall be supplied and installed on both ends of the cables, at termination points before cable glands.
- b) The cable numbers shall be punched on the cable number tags.

### **3.11 Working site**

- a) It will be the responsibility of the contractor to ascertain, at the time of laying of cables, what the terrace level will be.
- b) The contractor will be liable for any damage to cables caused by grading machines and/or other equipment.
- c) Before commencement of actual digging, the Contractor shall be required to peg out the proposed cable routes for the site manager's approval.
- d) The contractor is responsible for ascertaining what other installations are likely to be encountered when digging trenches. Due care shall be taken by the contractor not to damage such installations. Any costs incurred for the repairs of damaged installations shall be charged to the contractor's account.
- e) The working site shall be kept as clean and tidy as possible at all times. Disfiguring marks and stains resulting from handling and making off of cable ends, earthing etc., shall be removed. Cable trenches shall be maintained in a clean condition. Where required, water shall be pumped out of cable trenches.

### **3.12 Cable laying**

Cables shall be drawn into position using approved rollers and apparatus for negotiating corners without excessive bending or damage to the cable system.

### **3.13 Excavation of cable trenches**

- a) The contractor shall carry out excavations in accordance with SANS 1200 LC.
- b) All excavation in soft material shall be cut and trimmed to size and level.
- c) The tender price shall include for risk of collapse to sides of excavation, keeping excavation free of water and the removal and replacement of HV yard crusher stone where necessary. Prices are also to include the removal and replacement of paving where necessary.

### **3.14 Backfilling**

- a) Backfilling shall be carried out in accordance with SANS 1200 LC.
- b) All excavation in soft material shall be cut and trimmed to size and level.
- c) Backfilling shall be done with the soil excavated from the trench. Stone or other material which may cause damage to the cable serving shall be removed.
- d) Back-filling shall be compacted to 93% MOD AASHTO in layers not exceeding 150 mm in depth.

### **3.15 Cable entry points**

- a) Where cables enter the control building cable entry duct or culvert from the open excavation, a slot shall be broken through the side of the duct or culvert at a depth of 500 mm below ground level to accept the cables.
- b) After cables have been correctly positioned, the slot shall be sealed using a vermiculite plaster or other approved non-flammable equivalent material for the full thickness of the culvert wall and made good.

### **3.16 Earthing**

- a) The installation shall be earthed in accordance with SANS 10142-1.
- b) The metalwork including floodlighting distribution board, luminaires with control gear boxes, mast termination boards and mast junction boxes shall be bonded to earth wires.
- c) The contractor shall supply, install, terminate and connect all earth wires.

#### **3.16.1 Earthing at floodlighting mast: Base termination boards**

- a) Cable wire armouring of incoming and outgoing cables shall be connected inside the "Pratley" or equal cable gland termination box, where an earth tag shall be included.
- b) 4 mm<sup>2</sup> earth wire connections shall be made to an earth stud on the floodlight masts or towers from the incoming and outgoing cable armouring via the earth tags to ensure a good earth-mat connection

#### **3.16.2 Earthing at floodlighting mast: Platform junction boxes**

- a) Cable wire armouring of the incoming 4-core cable shall be connected inside the "Pratley" or equal cable gland termination box where an earth tag shall be included.
- b) A 4 mm<sup>2</sup> earth wire connection shall be made to the earth terminal busbar within the junction boxes.

#### **3.16.3 Earthing of luminaries at floodlighting mast platforms**

Earthing of luminaries at floodlighting mast platforms shall be done by using the third core of a 3 core cable.

### **3.17 Control of floodlighting**

The Operational floodlighting shall be controlled by weatherproof (IP66) switches positioned on the porch of the control building.

### **3.18 Electrical installation at floodlighting mast**

The contractor shall supply, install and connect the following:

#### **3.18.1 Termination board inside/at bottom of new masts**

- a) Terminal board mounted in a metallic hot dip galvanised box. The box shall be weatherproof and rated IP65 in accordance with SANS 60529.
- b) Terminal rails and circuit breaker rail shall be fixed within the box.
- c) Terminal blocks shall be used.
- d) A properly rated circuit breaker with shrouded cover shall be used.

### **3.18.2 Cable from mast termination board to the junction box**

- a) The cable shall be BVX4ECV (4 core, 4mm<sup>2</sup>) when 400W luminaires are used, and
- b) The cable shall be BVX4GCV (4 core, 10mm<sup>2</sup>) when 1000W luminaires are used.
- c) The cable shall be BVX4DCV (4 core, 2,5mm<sup>2</sup>) when 250W luminaires are used.
- d) The cable shall be calculated to ensure the correct size is used for the application.
- e) The cable shall be terminated with cable glands.

### **3.18.3 Junction box at mast platform**

- a) Electrical equipment shall be mounted within a stainless steel box.
- b) The box shall have a hinged door, with a pad lockable lever lock and stainless steel hinges.
- c) The box shall be weatherproof and rated IP65 in accordance with SANS 60529.
- d) Terminal rails and circuit breaker rail shall be fixed within the box.
- e) Terminal blocks with shrouded covers shall be used.
- f) The junction box shall be securely attached to the floodlighting mast platform using hot-dip galvanised zinc-coated flange clamps or bolts in accordance with SANS 121.

### **3.18.4 Cables from junction box to luminaires**

- a) The cable shall be the same size as the cable from the mast termination board to the junction box, and the cable shall be terminated with cable glands.
- b) The contractor shall only use black UV protected cables and cable glands.
- c) The cables shall be fixed with stainless steel cable ties to the steel work.

### **3.18.5 Luminaires**

- a) HPS and LED luminaires will be considered for Floodlighting.
- b) 250W HPS can be used for 10m masts and lower.
- c) 400W HPS can be used for 18m to 24m masts.
- d) 600W to 1000W HPS can be used for 30m masts and higher.
- e) LED luminaires can be considered for the above applications, if the load wattage of the LED luminaire is at least 50% less than the HPS luminaire, and the luminaire efficiency is 120 or more lumen per watt. The correct illumination levels shall still apply.
- f) Luminaires shall be supplied complete with control gear, lamp and mounting brackets with protractor scales.

#### **3.18.5.1 Technical requirements of luminaires**

- a) Manufacturer: xxxxxxxxxx
- b) Catalogue number: xxxxxxxxxx
- c) Lamp and control gear:
  - 1) 250W for up to 10m high masts.
  - 2) 400W for up to 24m high masts.
  - 3) 600W for 30m and higher masts.
  - 4) 1000W for 30m and higher masts.

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- 5) Clear tubular
- 6) Single Arc Tube
- 7) HPS Lamp
- 8) Efficiency 120 lumen/watt
- d) Beam Spread (in accordance with SANS 60598):
  - 1) Narrow beam
- e) Material and finish
  - 1) Luminaire body: Die cast aluminium LM6
  - 2) Control gear housing: Die cast aluminium LM6
  - 3) Luminaire diffuser: Armoured glass
  - 4) Luminaire reflector : Pure anodised smooth aluminium
  - 5) Luminaire deflector blade: Pure anodised aluminium
  - 6) Lamp replacement: Side mounted cast aluminium lampholder housing
  - 7) Degree of protection: IP65 (in accordance with SANS 60529)

#### **3.18.5.2 General requirement for the luminaires**

- a) HPS Luminaires shall comply with the requirements of SANS 60598.
- b) LED luminaires shall comply with the requirements of SANS 60598, EN 55015 and SANS 475
- c) Luminaires shall be designed and constructed in such a way that they are capable of operating properly without compromising safety, performance and physical deterioration during their expected life span under normal operating conditions.
- d) Luminaires shall be designed to facilitate ease of installation and maintenance. All connections, components and screws shall be easily accessible. Screws shall be of the captive type.
- e) Luminaires shall be weatherproof and designed to inhibit ingress of dirt and moisture.
- f) The luminaires body with all toggles, fixing screws, hinges and clips shall be manufactured of non-corrosive materials.
- g) Positive and substantial means of fixing to the luminaire mounting brackets shall be provided and designed to allow adjustment and to ensure that once set in the required position the luminaires remain fixed.
- h) Protractor scales shall be firmly fixed to floodlighting luminaries allowing for horizontal and vertical angular settings. The angular setting shall not be prone to alteration during lamp changing and cleaning operations.
- i) The control gear shall be integral or be accommodated in a robust, corrosion-free container attached to the luminaire mounting bracket.
- j) Ballasts shall comply with the requirements of SANS 1266.
- k) Capacitors shall comply with the requirements of SANS 1250.
- l) The electronic ignition device shall be suitable for the ballast and lamp supplied. It shall also be suitable for use with any other high-pressure sodium lamp currently available on the local market.
- m) Pulsing of the ignitor on a failed lamp shall not have a deleterious effect on ignitor, ballast, lamp holder or wiring.
- n) The wiring between control gear and luminaires shall be able to withstand associated voltage transients and temperatures.
- o) Luminaire enclosures shall be of armoured glass and heat-resistant.

### **3.19 Labelling**

- a) All labelling shall be in accordance with SANS 1186-1 where applicable.
- b) The following items of the electrical installation shall be labelled by the contractor:
  - 1) Floodlighting Distribution Board
  - 2) Mast termination boards.
  - 3) All trench junction boxes.
  - 4) All cables at both ends.
  - 5) All floodlighting masts

#### **3.19.1 Materials and method of attachment of label plates and warning safety signs**

##### **3.19.1.1 Mast termination boards**

- a) The label plate and warning safety sign at junction boxes shall be fabricated from sheet aluminium with a minimum thickness of 1 mm. Pop-rivets shall be used for fixing the label plate.
- b) Warning safety sign shall be in accordance with SANS 1186-1, Code WW7.

##### **3.19.1.2 Operational floodlighting masts**

- a) The label plate shall be fabricated from sheet aluminium with a minimum thickness of 2 mm.
- b) The label plate shall be bolted to the top of the floodlight concrete foundation.

### **3.20 Equipment to be inspected before delivery**

- a) Floodlight distribution board
- b) Luminaires with mounting brackets and protractor scales
- c) Floodlighting masts according to Eskom's requirements
- d) Mast base termination board boxes
- e) Mast platform junction boxes
- f) Control boxes

### **3.21 Factory inspection**

- a) Equipment specified above shall be inspected in the factory before delivery to site.
- b) The inspection shall entail a quality check by Eskom's Quality Assurance Representative to ensure complete compliance with this specification.

### **3.22 Testing**

- a) All installations shall, upon completion, be tested by an accredited person appointed by the Contractor.
- b) A certificate of compliance and notice of commencement of installation shall be issued in accordance with relevant regulations and procedures.

### **3.23 Electrical contractor**

The electrical contractor shall annually register with the relevant Electrical Contracting Board in accordance with the relevant regulations.

## **4. Authorization**

This document has been seen and accepted by:

<b>Name and surname</b>	<b>Designation</b>
Subhas Maharaj	Senior Manager Substation Engineering
Andile Maneli	Manager Substation Engineering

## **5. Revisions**

<b>Date</b>	<b>Rev</b>	<b>Compiler</b>	<b>Remarks</b>
April 2021	2	AR Naude	Document revised
Oct 2014	1	AR Naude	New document

## **6. Development team**

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

- Anton Naude

## **7. Acknowledgements**

Not applicable.

**Annex A – Technical Schedules A and B**

Schedule A : Eskom's particular requirements

Schedule B : Guarantees and technical particulars of equipment offered

Item No	Description	Schedule A	Schedule B
1	Cable Glands		
	Manufacturer/Supplier	xxxxxxxxxx	_____
	PVC cable gland catalogue no.	xxxxxxxxxx	_____
	Cable lugs/crimping tools	xxxxxxxxxx	_____
	IP Rating	IP65	_____
2	Floodlighting Luminaire		
	Manufacturer/Supplier	xxxxxxxxxx	_____
	Luminaire catalogue no.	xxxxxxxxxx	_____
	HPS Lamp	Clear Tube	_____
	Control Gear	xxxxxxxxxx	_____
	IP rating	IP65	_____
	Beam spread		_____
	Supply Voltage	230 V AC	_____
	Starting Current	xxxxxxxxxx	_____
	Running Current	xxxxxxxxxx	_____
	Power Factor	0.85	_____
3	Cable Trench Junction Boxes		
	Manufacturer/Supplier	xxxxxxxxxx	_____
	Cable Box catalogue no	xxxxxxxxxx	_____
	IP Rating	IP 68	_____
4	Mast Base Termination Board Boxes and Mast Platform Junction Boxes		
	Manufacturer/Supplier	xxxxxxxxxx	_____

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5	Box catalogue no.	xxxxxxx	_____
	IP rating	IP 65	_____
	Reticulation Cabling		_____
	Manufacturer	xxxxxxx	_____
	Voltage Rating : Phase V/ Line V	600/1000	_____
5.1	Conductor material	Copper	_____
	Cable size	BVX4#CV	_____
	Number of cores	4	_____
	Area of conductor : mm <sup>2</sup>	#	_____
	AC Resistance at 70°C : ohm/km	xxxxxxx	_____
5.2	AC Reactance at 70°C : ohm/km	xxxxxxx	_____
	BVX4LCV		_____
	Number of cores	4	_____
	Area of conductor : mm <sup>2</sup>	35	_____
	AC Resistance at 70°C : ohm/km	xxxxxxx	_____
5.3	AC Reactance at 70°C : ohm/km	xxxxxxx	_____
	BVX4ECV		_____
	Number of cores	4	_____
	Area of conductor : mm <sup>2</sup>	4	_____
	AC Resistance at 70°C : ohm/km	xxxxxxx	_____
5.4	AC Reactance at 70°C : ohm/km	xxxxxxx	_____
	BVV3ECV		_____
	Number of cores	3	_____
	Area of conductor : mm <sup>2</sup>	4	_____
	AC Resistance at 70°C : ohm/km	xxxxxxx	_____
	AC Reactance at 70°C : ohm/km	xxxxxxx	_____