



**Eskom**

**Standard**

**Technology**

Title: **SPECIFICATION FOR  
POLYMERIC LONGROD  
INSULATORS FOR AC  
TRANSMISSION VOLTAGES OF  
220KV AND ABOVE**

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## Content

	Page
1. Introduction .....	4
2. Supporting clauses .....	4
2.1 Scope .....	4
2.1.1 Purpose .....	4
2.1.2 Applicability .....	4
2.2 Normative/informative references .....	4
2.2.1 Normative .....	4
2.2.2 Informative .....	5
2.3 Definitions .....	5
2.3.1 General .....	5
2.3.2 Disclosure classification .....	6
2.4 Abbreviations .....	7
2.5 Roles and responsibilities .....	7
2.6 Process for monitoring .....	7
2.7 Related/supporting documents .....	7
3. Requirements .....	8
3.1 General .....	8
3.2 Insulator Design .....	8
3.3 Insulator approvals .....	8
3.4 Submissions by suppliers .....	8
3.4.1 Compliance .....	8
3.4.2 Drawings .....	8
3.4.3 Test Documentation .....	9
3.4.4 Other Submissions .....	9
3.4.5 Supplier ISO Certification Requirements .....	9
4. Product/process requirements .....	9
5. Testing requirements .....	11
5.1 Type, production and routine testing .....	11
5.2 Requirement for Pollution Performance qualification .....	11
5.3 Crimping test .....	12
5.4 Corona test .....	13
5.5 Impulse test .....	13
6. Identification requirements .....	13
7. Packing requirements .....	13
8. Storage, transport and handling .....	14
9. Manufacturer documentation (Hard-copy and Electronic) .....	15
10. Technical Evaluation Criteria .....	16
11. Authorization .....	17
12. Development team .....	17
13. Revisions .....	18
Annex A – Technical Schedules Sample .....	20

Tables

Table 1: Insulation Levels for Phase-to-earth application.....10

Table 2: Insulation Levels for Phase-to-Phase applications.....10

Table 3: Minimum Dry Arcing Distances.....10

## **1. Introduction**

This specification has been produced to rationalise the application of polymeric insulators in the Transmission Division, and to achieve maximum standardisation at an acceptable quality. It is restricted to silicone rubber material on overhead transmission lines and transmission substation conductor stringing. The Insulation Care Group (Plant SCOT) must be consulted on the application and suitability of polymeric insulators.

It is intended to use the insulators specified in this document for the construction of new overhead transmission lines, as well as for the maintenance and refurbishment of existing lines. However, construction and maintenance activities are not only restricted to the use of polymer type insulators. Glass and porcelain insulation has an appropriate application. The connecting lengths and end-fittings specified may be critical and, where necessary, any deviation from these and the tolerances provided will result in a commercial offer being invalidated.

Insulators for maintenance may not have standard connecting lengths or standard end-fittings and provision has been made in the attached schedules for specific requirements.

## **2. Supporting clauses**

### **2.1 Scope**

#### **2.1.1 Purpose**

The purpose of this specification is to ensure that polymeric longrod insulators of 220 kV nominal system voltages and above meet the technical requirements of this standard and as specified in Annex A.

#### **2.1.2 Applicability**

This specification shall be applicable to all Transmission voltage polymeric insulators used on the ESKOM infrastructure (overhead transmission lines, substations, capacitor and reactor bank stations etc.). It is for the construction of all new and refurbished, as well as for the maintenance of existing ESKOM infrastructure mentioned above.

This document shall apply throughout ESKOM Holdings Limited Divisions.

### **2.2 Normative/informative references**

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

#### **2.2.1 Normative**

- [1] SANS / IEC 60815: Guide for the selection of insulators in respect of polluted conditions.
- [2] SANS / IEC 60060: High voltage test techniques.
- [3] SANS / IEC 60120: Dimensions of ball and socket couplings of string insulator units.
- [4] SANS / IEC 60372: Locking devices for ball and socket couplings of string insulator units.
- [5] SANS / IEC 61109: Composite insulators for AC overhead lines with nominal voltages greater than 1000V.
- [6] SANS / IEC 62217: Polymeric Insulator for Indoor and Outdoor use with nominal voltage > 1000V – General definitions, test methods and acceptance criteria
- [7] ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories
- [8] Cigre TB 555 : Artificial pollution test for polymer insulators, WG C4.303, (2013-10)

- [9] Cigre TB 691 : Pollution test of naturally and artificially contaminated insulators, WG D1.44, (2017-07)
- [10] Cigre TB 184 : Composite insulator handling guide, WG 22.03, (2001-04).

## **2.2.2 Informative**

- [1] ISO 1461: Hot dipped galvanised coatings on fabricated iron and steel articles – specifications and test methods.
- [2] ISO 9001: Quality Management Systems - Requirements
- [3] ISO 14001:1 Environmental Management Systems Specification with guidance for use.
- [4] Eskom Procedure, E 32-846, Operating regulations for high voltage systems
- [5] 240-86601391: Technical Evaluation Standard For Glass Cap And Pin And Composite Long Rod Insulators For Systems With Nominal Voltages Up To 765kv, and for Porcelain and composite line post insulators for systems up to 132kV

## **2.3 Definitions**

### **2.3.1 General**

<b>Definition</b>	<b>Description</b>
<b>Acid resistant core</b>	A fiber glass reinforced plastic rod (FRP) produced from acid resistant glass fibers.
<b>Alternating shed profile</b>	A construction of the insulator where sheds of small and large diameters are placed in an alternating way
<b>Brittle fracture</b>	The fracture is characterised by a razor-cut like surface running perpendicular to the axis of the FRP rod. It is caused by acid induced stress corrosion
<b>Certified test report</b>	A certificate of successful tests required by the specification and carried out by, or witnessed by, an accredited authority
<b>Chips, pits or blisters</b>	Surface marks on the insulator shed material usually caused during the manufacturing process
<b>Connecting zone</b>	Zone where the load is transmitted between the rod and the metal end-fitting
<b>Core (of a polymeric insulator)</b>	The core is the internal insulating part of a polymeric insulator providing the mechanical strength. The core consists of millions of glass fibres in a resin-based matrix
<b>Coupling</b>	The part of the metal end-fitting that transmits the load to the line hardware external to the insulator
<b>Crack</b>	A surface fracture greater than 0,1 mm deep

Definition	Description
<b>Creepage distance</b>	The shortest distance or sum of the shortest distances measured along the contours of the external surfaces of the insulating parts between those parts of an insulator that normally have the operating voltage between them
<b>Delamination</b>	The loss of bonding of fibres to the matrix
<b>Dry-arcing distance</b>	The shortest distance through the surrounding medium between terminal electrodes, or the sum of the distances between intermediate electrodes, whichever is shorter
<b>Flashover</b>	A disruptive discharge external to an insulator between those parts of the insulator that normally have the operating voltage between them
<b>Housing</b>	The external part of an insulator that provides the necessary creepage distance and protects the core from exposure to the elements. An intermediate insulating sheath covering the FRP rod is part of the housing
<b>Insulator</b>	A device that provides both electrical insulation and mechanical linkage between live conductors and an earth point
<b>Metal fittings</b>	Devices that form part of an insulator and intended to connect it to a supporting structure or to a conductor. The two fittings referred to in this specification are the earth end and the line or live end
<b>Routine Test Load (RTL)</b>	This is 50% of the SML to which every insulator has to be subjected for 10 seconds
<b>Shed</b>	A projecting portion of the housing intended to increase the creepage distance
<b>Shed spacing to projection ratio (S/P)</b>	The ratio of the distance between two adjacent sheds to the length of the shed overhang. In the case of alternating sheds, two adjacent large-diameter sheds are considered, with the intermediate smaller shed neglected
<b>Specified Mechanical Load – SML (of long rod insulators)</b>	This is the load specified by the manufacturer which is used for mechanical tests
<b>Strain (tension) insulator</b>	An insulator subject to the tension of the conductors
<b>Lightning Impulse Withstand Level (LIWL)</b>	The crest value of the standard lightning impulse for which the insulation exhibits a 90% probability of withstand (10% probability of failure) under specified conditions applicable for self-restoring insulation
<b>Switching Impulse Withstand Level (SIWL)</b>	The crest value of the standard switching impulse for which the insulation exhibits a 90% probability of withstand (10% probability of failure) under specified conditions applicable for self-restoring insulation

### 2.3.2 Disclosure classification

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

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## 2.4 Abbreviations

Abbreviation	Description
LIWL	Lightning Impulse Withstand Level
kV	kiloVolts
m	metre
RIV	Radio Influence Voltage
rms	root mean square
SIWL	Switching Impulse Withstand Level
SML	Specified Mechanical Load
U <sub>m</sub>	Maximum System Operating Voltage
FRP	Fibreglass Reinforced Plastic
QITP	Quality Inspection Test Plan
S/P ratio	Shed spacing to projection ratio
RTL	Routine Test Load

## 2.5 Roles and responsibilities

Engineer – development and updating the document, approval of tenders and approval of suppliers

Buyer – to distribute this document to relevant supplier of composite longrod insulators

Project Manager – to verify the delivered of insulators meet the specification

## 2.6 Process for monitoring

Document number	Document title
DPC_34-04	Procedure For Management Of Technical Documents For SCOT.

## 2.7 Related/supporting documents

This document supersedes the following documents:

- TRMSCABS9 Rev.1 – Specification for polymeric long rod insulators for transmission voltages of 220kV and above
- TSP41-619 – Specification for polymeric long rod insulators for transmission voltages of 220kV and above

### **3. Requirements**

#### **3.1 General**

Nothing in this specification shall lessen the obligations of the supplier as detailed in any other documents forming part of a contract. The insulators shall be designed, manufactured, supplied, installed and tested as specified herein and in Technical Schedules of the Enquiry document.

#### **3.2 Insulator Design**

Within the minimum requirements specified in Technical Schedules of the Enquiry document, the suppliers shall be fully responsible for their designs and their satisfactory performance in service. Acceptance by ESKOM shall not relieve the supplier of his responsibility for the adequacy of the design, dimensions and details. Suppliers' catalogues shall not refer to any product as "ESKOM approved".

Suppliers' shall have access to the engineering facilities necessary to provide a technical service and information, advice and after-sales service related to the products under consideration. They may be requested to provide a list of references indicating the country, name of the customer, system voltage, quantity and year of delivery for substantial previous orders.

The insulators shall be designed and manufactured by an accredited ISO 9001 organisation.

#### **3.3 Insulator approvals**

Approval by ESKOM shall not relieve the supplier of his responsibility for the adequacy of the design, dimensions and details. ESKOM will use its Technical Approval Standard 240-86601391 to evaluate and approve all insulators offered.

#### **3.4 Submissions by suppliers**

The manufacturer shall include two copies of the general arrangement and construction drawings of the insulator(s) offered. See Annex A for Technical Schedules example.

The manufacturer's documentation shall include all relevant information and detail drawings shall clearly show the following information:

##### **3.4.1 Compliance**

The manufacturer shall include in their submission a clause indicating compliance in their schedule as proposed.

##### **3.4.2 Drawings**

- 1) Assembly and arrangements of proposals (Including corona ring(s)).
- 2) Itemised drawings to include;
  - a) Materials.
  - b) Dimensions.
  - c) Tolerances.
  - d) Specifications.
  - e) Identification of items.
  - f) End fittings.
- 3) Electric field modelling drawings to include these dimensions;
  - a) Live end fitting and the three adjacent sheds
  - b) Dead end fitting and the three adjacent sheds

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- c) Every dimension of the end fitting including radii of curvature at the end-fitting/rod/sheath interface
  - d) Shed dimensions (thickness/spacing/inclination angles)
  - e) Sheath thickness and diameters
  - f) Rod dimensions
  - g) Protrusion depth of the rod into both live and dead metal end-fitting
  - h) Exact dimensions and placement of the corona rings (both live and dead ends)

### **3.4.3 Test Documentation.**

- a) Valid Type Tests of complete product as per referred standards and specifications (i.e. SANS/IEC 62217, SANS/IEC 61109).
- b) Time-load curves illustrating the expectant life of the offered insulator, or insulators of similar dimensions and strengths, shall be submitted with the offer. Time load curves for any other insulator(s) will be considered irrelevant.
- c) Documentation of QITP (Quality Inspection and Test Plan) with respect to Routine Testing carried out during the manufacturing process.

### **3.4.4 Other Submissions**

The above technical submissions shall not lessen the tenderers obligations in terms of all the requirements stipulated in the enquiry documentation.

### **3.4.5 Supplier ISO Certification Requirements**

Proof of valid ISO9001 certification shall be submitted with the Tender/Enquiry.

## **4. Product/process requirements**

- a) The design parameters of the insulators shall be as specified in the Technical Schedules.
- b) Design of Insulator Range.
  - i. The offered product range shall conform to all the requirements contained in the normative references listed unless stated otherwise.
  - ii. ESKOM may request proof of type tests at any time.
  - iii. Suppliers shall show proof that all materials and technical requirements are maintained in accordance with the Type Test Records submitted.
  - iv. Product range approval shall be carried out by ESKOM and/or ESKOM appointed representative
- c) The insulator design shall ensure that the core is totally sealed and no part of the core shall become exposed during normal handling and use. Insulating materials shall have a minimum 3mm sheath cover thickness throughout the length of the insulator.
- d) Preference will be given for polymeric insulators that are constructed with alternating shed diameters with a S/P ratio of  $\geq 1.0$ .
- e) ESKOM prefers insulators with flat open (aerodynamic) profile on all the sheds. Where the insulators are not of the flat profile under the shed, the insulator will be deemed to be one IEC pollution class lower than the equivalent flat profile.
- f) All interfaces between the rod, sheath and sheds shall be chemically bonded together.
- g) The sheds and sheath shall have high resistance to tearing. It shall not tear when handled normally during storage, transport or installation.

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220KV AND ABOVE**

Unique Identifier: **240-77125772**Revision: **3**Page: **10 of 24**

- h) The metal end fittings and the epoxy resin acid resistant glass rod are to be joined by a compression technique and ultrasonic monitoring should be conducted (both of these will be witnessed during the factory evaluation). All non-ferrous items to be hot dipped galvanised in accordance with ISO 1461 as specified in Annex A and SANS / IEC 61109.
- i) Polymeric weather sheds shall maintain their shape and rigidity under normal operating conditions.
- j) All epoxy resin acid resistant glass rods are to have a low seed count.
- k) Depending on the application, only two specific creepage distances will be specified in the Technical Schedules. These shall be a minimum of 25mm/kV for Light to Medium and 31mm/kV for Heavy to Very Heavy pollution levels.
- l) The insulation levels of the insulators shall be in accordance with the relevant values in Table 1 for phase-to-earth and Table 2 for phase-to-phase applications.

**Table 1: Insulation Levels for Phase-to-earth application**

System Voltage kV (rms)		Impulse Withstand Voltage up to 1800m [kV <sub>(peak)</sub> ]		60 sec. Power frequency Withstand Voltage up to 1800m
Highest	Nominal	BIL	SIL	kV <sub>(rms)</sub>
245	220	850	-	360
300	275	1050	850	-
420	400	1425	1050	-
800	765	2100	1550	-

**Table 2: Insulation Levels for Phase-to-Phase applications**

System Voltage kV (rms)		Impulse Withstand Voltage up to 1800m [kV <sub>(peak)</sub> ]		60 sec. Power frequency Withstand Voltage up to 1800m
Highest	Nominal	BIL	SIL	kV <sub>(rms)</sub>
245	220	-	-	360
300	275	-	1300	-
420	400	-	1550	-
800	765	-	2400	-

- m) Unless otherwise specified, the dry arcing distance must be greater than or equal to the relevant clearance for phase-to-phase or phase-to-earth depending on the insulator application. These distances shall be in accordance with Table 3.

**Table 3: Minimum Dry Arcing Distances**

Highest system r.m.s. voltage	System nominal r.m.s. voltage	Clearance phase-to-earth	Clearance phase-to-phase
(kV)	(kV)	(m)	(m)
245	220	2.1	2.7
300	275	2.5	3.6
420	400	3.2	4.8
800	765	6.0	8.9

- n) Unless other specific configurations are called for, all end fittings should be of the ball and socket type and be in accordance with SANS / IEC 60120.

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- o) Epoxy resin acid resistant glass rod diameter must be a minimum of 16mm at a SML of 120kN.
- p) Corona rings shall be supplied as part of the insulator. They shall be fitted to the live end of all polymeric insulators. In the case of 400kV and above, corona rings shall be supplied for both the live and dead ends of the polymeric insulator. The dimensions of the corona ring shall be such that minimum phase-earth clearances are maintained. Corona rings, both insulator and hardware rings, shall not clash in any way. Corona rings shall be designed in such a way as to avoid partial discharge from the ring to the insulating material, even in a case of severe pollution. The rings shall be of the split type to allow maintenance or retrofitting. The average electric field for the first 10mm along the insulating surface of both the live and dead ends should be  $\leq 0.42\text{kV/mm}$ . On the end-fitting seal, the E-field should not exceed  $0.35\text{kV/mm}$ . The electric field stress on the grading ring should be  $<1.8\text{kV/mm}$ . Evidence of both these values need to be provided by the manufacturer. Locking devices shall be in accordance with SANS / IEC 60372, material and type of device is as per the Technical Schedule. The preferred material is stainless steel and phosphor bronze as an alternative.
- q) Unless explicitly stated, the insulator profile parameters must conform to the limits stated in the relevant part of SANS / IEC 60815

## **5. Testing requirements**

### **5.1 Type, production and routine testing**

Insulator shall be tested in accordance with SANS / IEC 62217 and SANS / IEC 61109.

The supplier must refer to Table 1 of IEC 61109 to determine the relevance of the test reports being quoted for the offered product. Attention must be paid to the "parent-child" relationship between the tested (parent) insulator and the offered (child) insulator. If the test report being used to support the offered product does not support this relationship, adequate justification must be provided by the supplier. In the absence of such justification, any test report that violates the requirements in IEC 61109 Table 1 will be considered invalid and may result in the offered product being disqualified.

Test certificates for sample and routine tests must accompany each batch of insulators delivered to site. It is recommended that each insulator be marked by the manufacture to show that it has passed routine mechanical test.

At its discretion, ESKOM reserves the right to subject randomly selected insulators that have been delivered to site, to tests. The costs of such testing shall be for ESKOM's account for insulators that pass the tests. For insulators that fail these tests, the cost shall be for the supplier's account. Failure to pass qualifying design tests will result in rejection of all insulators from the batch, until the problem is satisfactorily resolved.

### **5.2 Requirement for Pollution Performance qualification**

There are three approaches to insulator selection and dimensioning. This section focuses on approach 2 (Measure and Test), as per Table 1 in IEC TS 60815-1. This approach is to be used along with Section 12 of IEC TS 60815-3 which focuses on polymeric insulator products.

Reference reports will only be acceptable:

1. From a recognized, independent testing authority,
2. On a test insulator with identical IEC 60815 insulation profile to that of the offered insulator
3. With pollution ( $U_{50\%}$ ) withstand voltage curves at three pollution levels; SDD of 0.06, 0.12 and  $0.48\text{ mg/cm}^2$  with NSDD of  $\geq 0.1\text{ mg/cm}^2$ .

For polymeric insulators, tests should be performed in accordance with the modified Solid Layer test method (with pre-conditioning procedure, and with/without recovery) using the rapid flashover test method according to [8] and [9]. The test insulator must be identical in IEC 60815 profile and creepage factor to the offered insulator.

The test insulator pollution  $U_{50\%}$  withstand voltage, results above, are then converted into flashover stress along the test insulation length  $H_T$  as  $U_{50\%}/H_T$  in kV/m and presented as three point approximated power law curves against pollution level SDD in  $\text{mg}/\text{cm}^2$  as per Figure 1 below.

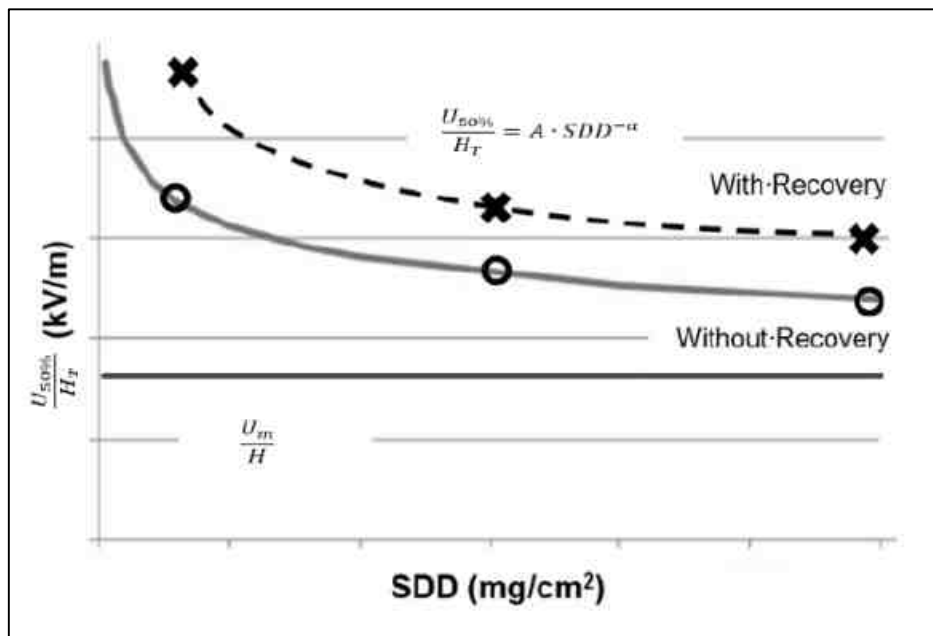


Figure 1: SDD Applicability

$U_m/H$  is calculated in kV/m using its insulation length  $H$ , and  $U_m$  the highest system r.m.s. phase to ground voltage that the supplied insulator will be subjected to.

This insulator will be accepted if  $U_{50\%}/H_T > U_m/H$  in the SDD range:

- 0.06 to 0.12  $\text{mg}/\text{cm}^2$  for use in Light to Medium environments
- and 0.12 to 0.48  $\text{mg}/\text{cm}^2$  for use in Heavy to Very Heavy environments

Insulator pollution flashover performance curve constants  $A$  in kV/m and  $\alpha$  are to be determined for the equation  $U_{50\%}/H_T = A \times SDD^{-\alpha}$  for use by Eskom along with Site Pollution Severity (SPS) in the statistical approach as per Annex G "Deterministic and statistical approaches for artificial pollution test severity and acceptance criteria" of IEC TS 60815-1 so as to optimise insulation selection.

Note: ESKOM reserves the right to subject randomly selected insulators that have been delivered to site, to undergo natural ageing and pollution performance tests at KIPTS. Should poor ageing and pollution performance be detected as a result of the KIPTS testing in the product, Eskom has the right to withhold further procurement until the defect is corrected by the manufacturer.

### 5.3 Crimping test

All end fittings shall be crimped to the fibre rod by means of a manufacturing method that must include automatic detection of cracks in all FRP rods during crimping process. In addition to this each and every insulator shall be subject to a routine test load (RTL) equal to 50% of the SML.

## **5.4 Corona test**

The manufacturer must guarantee corona-free performance of the offered insulator for the maximum system voltage at 1800m above mean sea level, by way of a test report (including corona imagery) or electric field modelling of the entire insulator including corona rings. An insulator will be considered acceptable if no evidence of visible corona exists at the equivalent phase-to-earth voltage. No corona shall be visible on any part of the insulator and especially at the interface of the metal and the insulating material of the insulator.

It must also be ensured that insulators comply with rational limits of RIV. The standing limit used by ESKOM is 65dB at 0,5MHz in dry conditions at local high altitudes. The rationale for this limit is that 65dB at 0,5MHz the hardware noise should be at least 6dB below that produced by a full conductor span in wet conditions.

In addition to radio-interference limits and power arc protection, it is important that the E-field on the insulator surface be limited to avoid the possibility of aging due to dry and water-induced corona. For this reason, the E-field on the insulator sheath should not be permitted to exceed 0.42kV/mm for more than 10mm along the insulator surface. On the end-fitting seal, the E-field should not exceed 0.35kV/mm. Configurations should be modelled using 3-D E-field simulations and/or laboratory testing can be considered.

The packaging should be properly marked to include instructions about the corona rings, especially relating to the correct placement and fitment.

## **5.5 Impulse test**

Test results, indicating compliance with electrical withstand levels for switching, lightning, and 60 sec power frequency where applicable, must be submitted.

Tests are to be conducted in accordance with SANS / IEC 60060 standard.

## **6. Identification requirements**

- a) The insulator shall be permanently marked with the following information:
  - i. manufacturer's name or trademark;
  - ii. SML;
  - iii. Type or model or serial number; and
  - iv. Batch number or batch date.
- b) The markings shall be legible and durable. Markings on sheds or housing shall remain legible for the life of the insulator.

## **7. Packing requirements**

- a) Details of the proposed packaging method shall accompany a tender offer and shall be subject to ESKOM approval. The packaging shall protect the insulator from the normal handling that can be expected from the point of dispatch to the point of construction and shall be rodent resistant.
- b) Any special handling requirements shall be clearly stated.
- c) The packaging shall be capable of protecting the insulators for sustained periods in storage. The supplier shall notify the purchaser of any special methods recommended for storage.
- d) The packaging shall not disintegrate due to any wetting and drying that may occur during the line construction. The supplier shall, at his expense, and at ESKOM's discretion, replace insulator units that are damaged due to unsuitable packaging.
- e) The supplier shall, at his expense, and at ESKOM's discretion, replace insulator units that are damaged during transit up to ESKOM's delivery point.
- f) If insulators are packed in boxes or crates on pallets, the gross weight of the pallets shall not exceed 1800 kg.

- g) Corona rings for the insulators shall be packaged separately and shipped with the correct insulator order. The packaging should be properly marked to include instructions about the corona rings, especially relating to the correct placement and fitment.
- h) Pallets shall be suitable for handling by fork-lift trucks, capable of two-way entry and be reversible.
- i) All boxes, pallets or containers shall be numbered and marked in accordance with the following example:

Project Name:	Suppliers Name:
Project Number:	Delivery Address:
	Order Number:
	Description of Material:
	Gross Weight:

## **8. Storage, transport and handling**

The supplier shall supply comprehensive instructions and guidelines as to the storage, transport and handling of all insulators according to [10]. This will include the handling care procedures during construction.

## **9. Manufacturer documentation (Hard-copy and Electronic)**

The following documentation is requested from the manufacturer. Documents for Schedule A:

- i. Completed Technical Schedules for each insulator type being offered. The supplier must clearly indicate any deviations appropriately.
- ii. Proof of valid ISO 9001 certification for the manufacture of polymeric insulators
- iii. QITP for the routine testing
- iv. References to at least 5 projects/lines outside the country of manufacture where the offered insulator is being used. References to other insulator strength classes, not being offered as part of the request, should be omitted. The references shall indicate the name of the transmission line and its operating voltage, month and year of delivery, completion and operation date, quantity and strength class of operated insulators, and names of the utility representatives, their titles, addresses, email addresses, and telephone and fax numbers for further communication. (Manufacturers based in South Africa will be exempted).
- v. Proof of 10 years of composite manufacturing, design, supply and service experience.
- vi. Handling, transportation, storage and installation guidelines (this includes the installation of the corona ring) giving due consideration of the length of the insulator, as the insulator needs to be protected against damage at all times.
- vii. Letter stating compliance and acceptance of the delivery schedules specified by ESKOM
- viii. Letter of acceptance to provide insulator samples upon the client's request. The full cost of supply of samples will be borne by the supplier.
- ix. Drawings for all offered insulators according to Section 3.4.2.
- x. Letter indicating an adequate production capacity for the offered insulators.
- xi. Letter of consent for the purchaser to carry out factory inspections and witnessing of sample and routine tests. As far as practicable, the manufacturing site, quality of materials, workmanship and testing of all insulators to be supplied shall be inspected if ESKOM so desires. Every facility is to be provided by the supplier to carry out the necessary inspection of the manufacture and the costs of all tests during manufacture and preparation of test records are to be borne by the supplier.

Documents for Schedule B:

- i. Test certificates, indicating the minimum and maximum temperature that composite insulators can withstand.
- ii. Time-load curves for insulators offered, or insulators of similar dimensions and strengths, shall be submitted with the offer. Time load curves for any other insulator(s) will be considered irrelevant.
- iii. Full type test reports from an accredited laboratory [7] for all required products
- iv. Pollution curves for the insulators offered.
- v. Evidence as per Section 5.4 that the electric field limit on both the live and dead end is less than 0.42 kV/mm for more than 10 mm along the insulator surface. On the end-fitting seal, the E-field should not exceed 0.35 kV/mm.

The requested documentation must be presented in an organized manner in the enquiry, preferably in the above sequence.

## **10. Technical Evaluation Criteria**

The evaluation of the manufacture and composite insulator(s) offered shall be done according to the Technical Evaluation Standard 240-86601391.



## 11. Authorization

This document has been seen and accepted by:

Name and surname	Designation
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## 12. Development team

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

- Sanjay Narain (Chief Engineer – Tx Insulators CG Chairman)
- Kaveer Ramharak (Engineer – Overhead Lines Electrical Engineer)
- Amish Roopnarain (Engineer – Overhead Lines Electrical Engineer)
- Raeesa Khan (Engineer – Overhead Lines Electrical Engineer)
- Sifiso Zikhali (Engineer – Overhead Lines Electrical Engineer)

**13. Revisions**

Date	Rev.	Compiler	Remarks
August 2014	1	S Zikhali	<p>Updated version of TSP41-619 on the new Group Technology Template.</p> <p>Included IEC/TR 62730 as part of the 5000hr test which was covered in SANS/IEC 61109</p> <p>Local suppliers exempted from providing a list of projects outside South Africa.</p> <p>DAD for 765kV changed from 5.5m to 6.0m</p> <p>ESKOM will only accept flat profile insulators</p> <p>Design Tests according to IEC62217</p> <p>Incorporated the following points from the project specific specifications approved by SCOT (Lines)</p> <ul style="list-style-type: none"> <li>• All SANS adopted IEC documents are accepted</li> <li>• Included new Manufacture's Documentation Requirements (Sect. 9)</li> <li>• Included Insulator evaluation criteria (Sect. 10)</li> <li>• The live and dead end electric field limits should be <math>\leq 0.42\text{kV/mm}</math> with these corona rings fitted. (Sect. 4 (p.))</li> <li>• Included drawing requirements (Sect 3.4.2)</li> </ul>
April 2016	2	S Zikhali	<p>Inclusion of the SANS / IEC 62217, 32-846 and ISO/IEC 17025 as part of the Normative references and criteria accepted by ESKOM. (Sect. 2.2)</p> <p>Both the 1000hr and 5000hr test are accepted by ESKOM. This decision was made by the SCOT Insulator CG: 19March2015. (Sect. 5.1)</p> <p>Changed the section to include (Sect. 5.3)</p> <p>Packaging should include corona rings separately and should include the instruction about them. (Sect. 7 (h))</p> <p>Included the request for QITPs instead of Quality Documents (Sect. 9(iii))</p> <p>Removed the evaluation criteria to the Evaluation Standard 240-86601391</p> <p>Change the Test requirements to include the SANS/IEC62217. (Appendix A: Schedule B)</p> <p>Corrected the SANS/IEC60061 to 60060</p> <p>Removed the Scoring on the Sample Technical Schedules (Annex A)</p>

**SPECIFICATION FOR POLYMERIC LONGROD  
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220KV AND ABOVE**

Unique Identifier: **240-77125772**

Revision: **3**

Page: **19 of 24**

Date	Rev.	Compiler	Remarks
August 2019	3	Kaveer Ramharak	Section 5.2 added to include the Requirement for Pollution Performance qualification. Emphasis on IEC/SANS 61109 on the 'parent-child' relationship. Added E-field limits and configurations should be modelled using 3-D E-field simulations and/or laboratory testing can be considered to Section 5.4.

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## **Annex A – Technical Schedules Sample**

Procurement to ensure the insulator supplier fills in these details at the time of enquiry. Any deviations or alternatives should clearly be indicated on these schedules.

### **SCHEDULE A: SUPPLIER RESPONSIVENESS**

<b>No</b>	<b>Item</b>	<b>Comply (Y/N)</b>	<b>Comments</b>
1	Complete Schedules A, B and C.		
2	ISO 9001 certification provided		
3	QITP for the routine testing		
4	Reference list of supply to projects outside the country		
5	Proof of 10 years manufacturing experience		
6	Transport, Handling, Storage and Installation Guidelines		
7	Delivery schedules adherence letter		
8	Ability to provide samples letter		
9	Detailed drawings provided		
10	Production capacity letter		
11	Allowance for manufacturing inspections and witnessing of tests letter		
<b>Deviations:</b>			

## SCHEDULE B: TEST MATRIX

		Item Number as per Annex A convention :						
Test		File name of electronic test report submitted	Applicable page number	Product code used in type test report	Full product code of item offered	Name of test facility and electronic file name of accreditation certificate/evidence	Comments	Outcome Passed /Failed
1	Max. Temp certificate							
2	Time load curve provided							
3	<b>SANS/IEC1109 DESIGN TEST certificate report ref. no.</b>							
3a	Tests on interfaces & connections included							
3b	Assembled core load time tests included							
3c	Tests of core material included							
3d	Flammability test included							
4	<b>SANS/IEC1109 TYPE TEST Certificate report ref. no.</b>							
4a	Dry lightning impulse withstand included							
4b	Wet power frequency withstand included							
4c	Wet switching impulse withstand included							
4d	Mechanical load time tests & tightness of interface included							
4e	Radio interference tests included							
4f	Power arc tests included							

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Unique Identifier: **240-77125772**

Revision: **3**

Page: **22 of 24**

5	Pollution curves as per Section 9							
6	<b>1000hr Test, 5000hr Test and Tests for Tracking and erosion included (IEC TR 62730 and IEC 62217)</b>							
7	Evidence of E-field limits of 0.42 and 0.35 kV/mm as per Section 5.4							
8	Insulator Form Factor							

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**SCHEDULE C: INSULATOR REQUIREMENTS**

INSULATOR TYPE	? KN INSULATORS		
Conceptual Design Drawing No.	Check conceptual drawing attached as per project/tender specification		
PARAMETER	CLIENT REQUIREMENTS	Comply (Y/N)	Comments
MODEL Number			
Shed Material	Silicone-based		
Open Profile	Flat sheds		
Alternating Sheds	Preferred		
Core Cover Thickness	≥ 3mm		
Life Expectancy	50 years		
Altitude of Application	1800m		
Temperatures :	Minimum -5 °C Maximum 50°C Average 30 °C		
Specific Creepage	≥ (25/31) mm/kV		
S/P Ratio	≥ 1.0		
BIL (+) – (@altitude)	kV		
SIL (+) – (@altitude)	kV		
Dry-arcing distance (DAD) with corona rings	mm		
Connecting Length	Shortest Possible Considering DAD limit		
Corona Rings ( ) :	Live/dead/both		
Type	Split type		
Dimensions	Live end		
	Dead end		
Ratings (kA/s)	Live end		
	Dead end		
SML	kN		
End fittings :			
Type	Ball-Socket/ Clevis types/ Oval Eye		
Size	mm		
IEC120	(Y/N)		
<b>Deviations:</b>			

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Unique Identifier: **240-77125772**Revision: **3**Page: **24 of 24****SCHEDULE D: GROUNDWIRE INSULATOR**

INSULATOR TYPE	GROUNDWIRE INSULATOR		
Conceptual Design Drawing No.	Check conceptual drawing attached as per project/tender specification		
PARAMETER	USER REQUIREMENTS	Comply (Y/N)	Comments
MODEL Number			
Shed Material	Silicone-based		
Standards	Comply with SANS / IEC 60815, SANS / IEC 61109/ IEC 62217		
Corecover Thickness	$\geq 3$ mm		
Insulator Class	Class A		
Connecting Length	375 ( $\pm 12$ ) mm		
Creepage length	$\geq 174$ mm		
60s Power Frequency Withstand (Dry)	50 kV (without arcing horns)		
60s Power Frequency Withstand (Wet)	25 kV (without arcing horns)		
Lightning positive impulse withstand	80 kV (without arcing horns)		
Minimum mechanical strength	120 kN		
Coupling method	In-line tongue & clevis caps in accordance with SANS / IEC 60471 size 16L		
Arcing horn shape	"Jacob's Ladder" with minimum straight horn lengths of 50mm and an angle of $60 \pm 5$ degrees between them		
Arcing horn bending radius	$\geq 2$ times the arcing horn rod/bar diameter at base		
Arcing horn material	Hot dipped galvanized forged steel		
Arcing horn cross sectional area	$> 18$ mm <sup>2</sup> each		
Arcing horn gap size	8 ( $\pm 2$ ) mm fixed		
<b>Deviations:</b>			

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