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1	A specific plant, project or solution	
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3	Established and accepted practices.	x

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Content

Foreword

This standard was developed to provide insight as to how critical damage to composite insulators can occur in the field and the measures that should be taken to avoid such damage.

Revision history

This revision cancels and replaces revision no. 0 of document no. SCSAGAAR0

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Sept 2009	0	-	**Compiled By:** A.K Persadh
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Authorisation

This document has been seen and accepted by:	
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This guide shall apply throughout Eskom Holdings Limited, its divisions, subsidiaries and entities wherein Eskom has a controlling interest. It is paramount to ensure that all necessary safety measures are taken where applicable.

Development team

This guide was initially prepared by a work group comprising the following members:

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Introduction

Following several failures of composite insulators in service on the Eskom system, the cause of which can be attributed to maltreatment during transport and/or installation, coupled with significant evidence of insulator damage on recently commissioned lines, the need for more careful handling of the insulators is apparent.

The "unbreakable", "vandal-resistant", nature of composite insulators was strongly promoted during their introduction and thus it should not be surprising that they are treated roughly on site. Although they are flexible and will not chip, crack or shatter like the more brittle glass and ceramic materials, incorrect loading of the units or damage to the moisture seal, for example, can precipitate complete mechanical and/or electrical breakdown. Moreover, the damage may not be clearly visible and, with the consequent mechanisms of failure being time-related, unexpected fracture can occur after a few years of service.

With a view to preventing such failures, this document describes how critical damage can occur in the field and the measures that should be taken to avoid such damage. Typical problems are illustrated to show the defects that can be introduced by inappropriate treatment and construction practices, to indicate the possible long term effects of such defects and to assist in their identification to facilitate the rigorous inspection of composite insulators prior to line commissioning.

1 Scope

This guideline covers the storage, transportation and handling of composite insulators in Eskom distribution.

2 Normative references

Parties using this guide shall apply the most recent edition of the documents listed below:

NOTE When issuing an enquiry based on this specification, it should be stated in the enquiry that the editions of the normative references that are current at the date of issue of the enquiry shall apply, unless otherwise agreed with Eskom. However in special cases, the responsible engineer may rule that the editions of one or more normative references applicable at the effective date of the Eskom specification shall apply.

SABS IEC 120: 1984, Dimensions of ball and socket couplings of string insulator units.

SABS IEC 815:1986 (1993), Guide *for the selection of insulators in respect of polluted conditions*

SABS IEC 1109:1992 (1993), Composite *insulators for a.c. overhead lines with a nominal voltage greater than 1000V — Definitions, test methods and acceptance criteria*.

ESKASAAV7: Rev 0*, Quality requirements for the procurement of quality related assets, goods and services.*

SCSSCAAG9: Rev 8, Outdoor post and longrod insulators for new and refurbished power lines up to

132 kV

3 Requirements

3.1 Manufacture and shipping

a) Insulator units shall be packed in crates that conform to the requirements of Clause 4.20 of the Distribution specification SCSSCAAG9.

b) Insulator units shall be packed in crates with solid walls to prevent rodent attack (See photo 1 in Annex C for an example of rodent attack).

c) Insulators must be secured inside the crates to ensure that units do not move around during transport. Any separate items or accessories packed with the insulators, such as arcing horns or corona rings, shall be properly secured within the crate.

d) A packing list providing the quantities and type numbers of the insulators contained shall be attached to the outside of the crate. The handling instructions must be within a waterproof packaging to protect it from weather conditions. A copy of the manufacturer's handling instructions shall be placed on top of the insulators in each crate.

e) Each insulator shall be indelibly marked to facilitate clear identification. Each insulator shall be marked on the top shed with the manufacturer's name or logo, its complete unique type number, production batch number, batch date and creepage. A typical example is shown in Photo 2.

3.2 Stores receipt

a) On arrival at the stores, check that the quantities and type numbers of the insulators given in the Eskom order, the manufacturer's packaging slips and the supplier's delivery note agree.

b) Each crate shall be examined for any signs of damage e.g. breakage due to dropping, a forklift tine having penetrated the wall or collapse owing to excessive weight having been packed on top.

c) Where crate damage is evident:

- The supplier must be immediately advised and the crate set aside for inspection by the manufacturer's representative, his insurance assessor and the relevant Eskom technical and quality assurance personnel;
- Each insulator in the damaged crate shall be checked to ensure that there is no damage to the sheath, sheds, the end sealing or the metal fittings;
- Any units found with sheath or seal damage shall be immediately rejected.

d) Where no crate damage is evident:

- The extent of the quality control applied on receipt of the goods could vary with, for example, the voltage of the insulators, the strategic nature of the project for which they were purchased, or the reputation of the supplier.

e) Quality assurance personnel may undertake to inspect a small sample of the crate contents.

- Where this is done, most of the original packaging shall be left undisturbed for subsequent storage and transport to site.

f) Where a crate is to be opened to examine insulators:

- Open carefully keeping all tools used away from the insulators;
- After removal of the lid, remove or flatten any exposed nails.

An example of this is shown in Photo 3.

g) A thorough inspection of insulators or samples shall incorporate all or some of the following:

1) Visual Checks

- Confirm that the type numbers on the insulators are the same as those on the order.
  - Confirm that the number of sheds is the same as those shown on the drawing.
  - Confirm that the end fittings are the type shown on the drawing and that they are on the correct ends.
  - Confirm that the end fittings are complete with the required cotter pins, clevis pins, split pins and washers as applicable.
  - Confirm that all the corona rings or arcing horns have been included where applicable.

2) Dimensional Checks

- Confirm that the connecting length agrees with that on the drawing.
- Confirm that the shed diameter agrees with that on the drawing.
- Confirm that the core diameter agrees with that on the drawing.
- Confirm that the clevis and tongue widths and clevis pin diameters are in accordance with the drawing.
- Confirm that the ball and socket fittings accept / do not accept the appropriate go and no-go gauges as defined in SABS IEC 120.

3) Other Checks

- Confirm galvanizing quality by measurement with a thickness gauge.
- Confirm by means of sampling and laboratory testing, that the shed and housing material is of the type specified and/or matches approved samples.

h) Following inspection of the insulators:

- On replacement of the lid, ensure that no nails, staples or other sharp objects can come into contact with the insulators.
- Insulators and other components shall be returned to their original packing and properly secured.
- If the crates were strapped, they shall be re-strapped.
- A “Receipt Checklist” as set out in Annex A, shall be completed for each crate received.

3.3 Storage

a) The insulators shall be stored indoors in their original packaging.

- Crates shall be raised off the ground and stored in areas free of standing water and other contaminants such as oils and petroleum derivatives.
- Crates shall be sealed to prevent rodent entry.

b) Where insulators have to be uncrated:

- No additional material must be placed or stored on top of them.
- If they are stacked, care must be taken that the metal ware does not make contact with the housings of adjacent units. This is particularly important for line post units, which have heavy bases and often have sharp corners.

c) For uncrated long rod insulators:

- Storage in plastic pipes, as shown in Photo 4, offers good protection.
- Alternatively, they can be hung from suitably designed racks with free-swinging hook, tongue or ball attachments as appropriate.

- Moving, loading and unloading of the crates with a forklift shall be undertaken with due caution.

3.4 Transport to site

a) Wherever possible, the insulators shall be transported to site in their original, sealed shipping crates.

b) Where only part of a crate requires delivery, insulators need to be removed from the manufacturer's packaging:

- Insulators shall not be transported loosely or without adequate protection.
- No other materials shall be placed on top of the insulators during transport.
- Insulators shall not be tied down or tied together with chains, ropes, etc.
- Insulators shall only be transported to site when required.

3.5 On site handling

a) On arrival at the construction site, the crate shall again be carefully checked.

- If any signs of breakage or rough treatment are evident, each insulator must be examined for signs of damage.
- Any insulator with sheath or end seal damage shall immediately be rejected.

b) A thorough inspection of insulators shall be undertaken on site.

This inspection could follow some or all of the criteria mentioned in 4.2.

c) Insulators shall be kept in their original packaging for as long as possible.

- Insulators shall be stored in a dry, covered area with the crates raised off the ground.
- Lids shall remain sealed to prevent rodent entry.
- Where rodent damage is evident, each insulator must be closely examined for damage to the sheath. Insulators exhibiting minor biting of the periphery of the sheds are possibly still acceptable for installation and shall be referred to the Project Engineer for a decision on their use.

d) When a crate is opened on site:

- Open carefully keeping all tools used away from the insulators.
- After removal of the lid, remove or flatten any exposed nails.

An example of this is shown in Photo 3.

e) During transport of insulators to structures:

- Insulators shall not be transported loosely or without adequate protection.
- Insulators shall not be tied down or tied together with chains, ropes, etc.

- Insulators shall only be transported to site when required.
- No additional material shall be placed or stored on top of insulators.
- If they are stacked, care shall be taken that the metalware does not make contact with the housings of adjacent units.
- Insulators shall be kept away from possible contaminants and abrasive materials.

f) Insulators that are left at the point of installation shall be adequately protected.

Stacking and storage shown in Photo 5 shall be avoided.

g) The potential for damage is reduced if the delivery of the insulators to their installation position is properly planned so as to occur immediately before they are required and they are thus not left on the ground for lengthy periods.

h) Use temporary packaging where insulators are to be stored on site. This packing may take the form of the example given in Photo 6.

An alternative technique for insulator protection is the application of a wrap-on shield as soon as the unit is removed from its original packing. As shown in Photos 7, 8, 9 and 10, these devices are easily fitted and, as they leave the end fittings exposed, can be left in place until the line construction is complete.

i) A “Site Receipt Checklist” as set out in Annex B, shall be completed for each crate or part of a crate received on site.

3.6 Insulator installation

a) Prior to installation, the insulator shall be examined for:

- damage to sheath, sheds and end seals;
- any nicks, cuts or indentations in the polymer material;
- exposed fibre-glass core.

b) Insulators of connecting length less than 2,5m may be safely lifted by one person holding the core at a central point.

- Longer units shall be lifted and carried by two persons holding the insulator about half a metre from each end. As a general rule-of-thumb, it shall be ensured that the angle of deflection on either side of the holding point is maintained at less than 300 to the horizontal.
- The insulators shall not be dragged along the ground.

c) Lifting lines or ropes shall be attached to the metal caps of the insulators and not the sheds or rods.

d) Large line post insulators shall be carefully lifted in a horizontal position using two slings.

3.7 Specific precautions for line post insulators

a) Before an insulator is attached to a pole, the following checks shall be carried out:

- that the application for that insulator is correct;
- the type number printed on the live-end shed of the line post agrees with that on the structure drawing;
- line posts with a lower strength rating may be specified for use in jumper support positions: these shall not be used as normal suspension insulators.

b) Cantilever stress shall be avoided where single steel or concrete pole structures are dressed with horizontal line post insulators.

- Before being lifted into position, it is important that the pole is supported well above the ground on suitable trestles.
- The position of the sling on the pole must be fixed with a pin or locating lug and arranged in such a way that it cannot come into contact with, or apply bending loads to, the insulators.

c) When fitting horizontal line posts to the pole, do not deform the base of the post in any way in order to make it fit the shape of the pole. See Photo 11.

d) The bolts for fitting horizontal line posts shall be torqued to the following recommended values:

M16	95Nm
M20	185Nm
M24	320Nm

e) Do not step or climb on the insulators or their corona rings.

Owing to the nature and geometry of the structure, horizontal line posts mounted on single poles are, often stood on and/or used to crawl out to the conductor attachment point. Sheath and shed damage from boots, safety belt buckles and the like is thus common, as illustrated in Photos 12 and 13.

f) Suitable working platforms shall be mounted on the pole or bucket trucks used for work on the live end of the insulators wherever possible. A typical working platform is shown in Photos 14 and 15. These shall be as light as possible but designed to accommodate the weight of at least two persons.

g) When working from a bucket or cage, care shall be taken that the insulators are not struck or stressed by the equipment. Photos 16 and 17 illustrate how adjacent insulators can be damaged when concentrating on one particular phase.

h) Ladders, tools, blocks and other equipment shall be prevented from coming into contact with the insulator housings. Particular care shall be taken on angle suspension poles where pulling equipment may be employed in close proximity to the insulator to facilitate conductor attachment.

i) Do not throw a line or rope over the post insulator to pull other components to the pole top. An example of sheath damage caused by this is provided in Photo 18.

j) If protective sleeves have been fitted to the insulators, they shall be left in place until stringing and installation of the conductor accessories is complete.

k) The keeper pieces of most trunnion clamps are reversible to facilitate the accommodation of a wide range of conductor sizes.

A typical trunnion clamp is shown in Photo 19.

l) Steel and concrete poles shall be provided with appropriate fittings for the rigid attachment of climbing ladders which can serve as a stable base from which to work.

Examples of effective and practical systems are illustrated in Photos 20 and 21.

m) The insulators shall not be used as anchoring points for tools and safety belts.

3.8 Specific precautions for long rod insulators

a) Before attachment to the pole or attachment of the string hardware, check that the insulator is being correctly applied.

b) The insulator and all string hardware shall be assembled while still on the ground.

c) Assemble the insulator strings in accordance with the drawing. The use of a ground sheet is illustrated in Photo 22.

d) Care shall be taken that no bending loads are applied to the insulators during attachment of the hardware or lifting of the assemblies to the pole top.

e) The lifting line shall be attached to the earth-end insulator cap or fitting only.

f) The earth end hardware shall be designed to allow the insulator to swing freely in all directions.

g) The attachment to the cross-arm shall be checked that it is, in fact, free before any load or weight is applied to the insulator string.

Photo 23 shows that while the bottom phase is hanging free and carrying only a tensile load, the top phase hardware is not permitting freedom of movement and the insulator is bending.

Photo 24 shows a terminal pole where the hardware does not have vertical mobility. The lower clevis ball is also held horizontally owing to the orientation of the turnbuckle eye. Any weight applied to this assembly could result in damage to the insulator and metalware.

Photo 25 illustrates an insulator at severe risk of being fractured owing to the lack of hardware mobility.

h) Do not throw a line or rope over the strain insulator to pull other components to the pole top.

An example of sheath damage caused by this is provided in Photo 26.

i) If protective sleeves have been fitted to the insulators, they shall be left in place until stringing and installation of the conductor accessories are complete.

j) If corona rings are to be fitted, ensure that these are properly located and the mounting bolts tightened to the manufacturer's recommended torque.

A loose ring lying on the insulator can wear through the core and cause the line to drop.

An example of this dangerous situation is provided in Photo 27.

k) Do not step or climb on the insulators or their corona rings.

For strain strings on single pole lines, the use of a working platform as shown in Photo 14 is far preferable to the technique shown in Photo 28.

3.9 Conductor stringing

During stringing operations it is critically important that the long rod insulators are not subjected to bending or torsional loads. Ensure that all safety measures are followed through.

a) A proper stringing swivel shall be used when tensioning the conductor.

The arrangement shown in Photo 29 is not adequate to allow the necessary untwisting of the wire.

a) The conductor shall be rolled off the drums and carefully handled to avoid the formation of loops and twists which could, on tensioning, apply a torsional stress to the insulator.

b) Situations as illustrated in Photo 30 shall be avoided.

c) Under no circumstances shall attempts be made to untwist conductor bundles by rotating the insulator or string hardware.

d) Ensure that all tensioning equipment is kept well clear of the insulators.

e) The tensioning equipment shall be attached to the pole itself and the operation undertaken with the strain string, keep well out of the way as shown in Photo 31. An alternative tensioning technique is illustrated in Photo 32.

f) If turnbuckles are provided in the assembly for final sag adjustment, the insulator end cap shall be held in position and prevented from rotating while the turnbuckle is tightened or loosened.

g) Under no circumstances shall the insulator be allowed to twist. The correct technique is shown in Photo 33.

h) For vertical suspension strings, ensure that the insulators are able to swing freely and follow the movement of the running-out blocks without being subjected to any bending stress.

i) All running-out blocks shall be checked and serviced where necessary, prior to conductor stringing.

j) Appropriate sag charts, stringing charts sighting boards and dynamometers shall be used during stringing to ensure that insulators are not overstressed.

k) Photo 34 shows the damage to a line post insulator caused by inadequate control and measurement of the stringing tension.

3.10 Insulator inspection

On undertaking an inspection prior to the commissioning of a line, the insulators shall be examined for the following:

l) Damage to the sheath resulting in exposure of the core (Refer to Photo 35);

m) Splitting of the sheath resulting in exposure of the core (Refer to Photo 36);

n) Those insulators with sheds that are not bonded to the core, shall be examined for exposure of the core due to movement of the sheds (Refer to Photo 37);

o) Damage to the end seals where the rod enters the caps (Refer to Photo 38);

p) Broken or torn sheds (Refer to photo 35 and 39);

q) A split in the sheath which may reflect a corresponding split in the core caused by severe cantilever or torsional loading (Refer to Photo 40);

r) A misalignment of the clevis and tongue end fittings that would indicate that the insulator has been subjected to, or is being subjected to, a torsional stress;

s) Marks on the end caps that indicate that the insulator may have been subjected to bending, torsional or impact forces (Refer to Photo 41);

t) Severe deflection of line post insulators (Refer to Photo 42);

u) Loose bolts, missing split pins, incorrectly applied corona rings, etc (Refer to Photos 27 and 3);

v) Insulator types in incorrect positions and errors in the string hardware assembly.

4 Mechanisms of failure

It is evident that the practices, techniques and procedures described in this document are designed to limit mishandling of composite insulators. They are primarily designed to:

- limit the bending and/or torsional forces;
- prevent exposure of the cores to moisture by either housing, sheath or end seal damage.

The mechanisms of the failures that will result from these defects are described below.

4.1 Core de-lamination and breakage

The internal core of a composite long rod insulator comprises several million continuous unidirectional glass fibres, running longitudinally from end cap to end cap, encapsulated in an epoxy, vinylester or polyester resin. This results in extremely high tensile strength but not, unfortunately, resistance to damage by cantilever, torsional or compressive stresses.

Bending of a rod places half of its cross-section in tension and the other half in compression. The two regions are separated by a neutral axis. When taken past its elastic limit, something has to give and the rod starts to de-laminate and splits down the neutral axis. As the bending progresses, this split will propagate over the full length of the rod. With further bending, the side of the rod in compression - the material being much weaker in compression than tension will start to fracture.

When placed on the line, insulators with partially fractured cores as described above may remain in service for a number of years before further deterioration of the fibres and, perhaps, a temporary increase in load due to high winds or cold temperatures, precipitates complete failure and dropping of the line.

An insulator which has failed in this manner is shown in Photo A1. The flat break at right angles to the core axis represents the side of the core that, on bending, was in compression, and the ragged area of the break, that part that was in tension.

If an insulator with a core that has been split by bending is installed in a lightly loaded position on the line, e.g. in a suspension string, the problem may not manifest itself as a mechanical failure but internal electrical breakdown may occur resulting in tripping of the line. The unit shown in Photo A2 failed in this way.

4.2 Brittle fracture

The ingress of moisture to the insulator core can result in a mode of failure commonly referred to as "brittle fracture". It is a stress corrosion mechanism precipitated by an acid attack of the glass fibres. The acid can originate from external sources, e.g. acid rain, but is thought to be more usually generated on or in the insulator by the action of partial discharges in the presence of water vapour - this producing nitric acid. Brittle fractures thus normally occur on insulators which are subjected to a high tensile load such as strain insulators and at the live end where the electrical stress is greatest. The unit with sheath damage shown in Photo 35 is thus particularly vulnerable to brittle fracture.

When acid comes into contact with the glass fibres, an exchange of certain ions between the acid and the glass takes place. This leads to stresses in the fibre which produce spiral breakage, as shown in Photo A3.

Normally, any micro-crack on the rod surface will propagate through the resin matrix and stop at a glass fibre. If, however, acid gains access to the crack, the fibre is attacked and breaks and the crack proceeds to the next fibre. Successive breaks will generally occur in the plane of the advancing crack. Depending, though, on the matrix to fibre bond, the acid can also migrate longitudinally thus causing continuation of the crack further along the rod resulting in a stepped break. With a constant tension applied to the ends of the rod, as the crack advances, the stress at the crack front steadily increases and propagation accelerates. Ultimately the remaining fibres can no longer support the load and a conventional tensile failure of these occurs.

As there is no means of detecting the brittle fracture process in service, and with the potentially serious consequences of such a failure of the insulator, the need to ensure that the integrity of the insulator housing, sheath and end seals is maintained cannot be over-emphasised.

It should be noted that damage to the core and sheath by the application of bending or torsional loads, followed by the consequent ingress of moisture, can lead to the ultimate failure of the insulator by a combination of both mechanical breakage and brittle fracture.

5 Design considerations

Although the design of the line cannot fully eliminate the risk of insulator damage on installation, certain features and considerations can reduce the probability of failure.

6 Cardanic mobility

The method of attachment of the insulator string to the tower and the composition of the components in the string assembly shall be selected to provide freedom of movement of the insulator in all directions. If this is not achieved, the chance of exposing the insulator to cantilever stresses is considerably increased.

Care shall be taken that assemblies which appear extremely flexible on paper are in fact so. For example, clevis fittings and shackles when attached to oval eyes may have only very limited movement in one direction. Where shackles can be installed either way round, freedom of movement planned in the design may not be realized in the field. As shown in Photo 24, swing of the assembly may be prevented by the width of the landing plate on the cross arm.

6.1 Component Selection

All hardware components and the insulator fittings shall couple easily without the need of force. It must be ensured that the clevis, tongue, ball and socket sizes provided on the insulator match those of the adjacent hardware.

The use of turnbuckles in strain strings does introduce the possibility that the insulators are subjected to torsional loads during final sag adjustment.

When specifying line post trunnion clamp sizes, make sure that the armour rod diameters, where applicable, are taken into account.

6.2 Accessibility

For monopole designs, the provision of adequate, stable ladders from which to work will reduce the necessity to climb or stand on the insulators.

6.3 Drawings

It is important that the pole and assembly drawings available on site not only clearly show the make-up of the components in the strings but also display the insulator type number. This is particularly necessary where, for example, line posts of different strength ratings are used for suspension and jumper support positions or different long rods are used at strain and suspension points.

Annex A - Model receipt and storage checklist

(informative)

ORDER NO: ____________________

TYPE NO: ____________________

PROJECT: ____

SUPPLIER: ______________ QUANTITY _______

Specification	CHECKED		Remarks
	Yes	No	
Crate in sound condition			
Type number on insulator			
Number of sheds			
Live end fitting type			
Live end fitting size	mm		
Live end nuts, bolts, pins included			
Earth end fitting type			
Earth end fitting size	mm		
Earth end nuts, bolts, pins included			
Corona rings included			
Connecting length	mm		
Alternating sheds			
Shed diameter 1	mm		
Shed diameter 2	mm		
Core diameter	mm		
Galvanizing thickness	μm		
Shed material type			
Is crate damaged?			
Have all units been examined?			
CRATE APPROVED FOR RELEASE TO SITE			

Inspected by: ________________________________

Signature: ________________________________

Date: ________________________________

Annex B - Model of site receipt checklist

(informative)

ORDER NO: ____________________

TYPE NO: ____________________

PROJECT: ____

SUPPLIER: ______________ QUANTITY _______

Specification	Checked		Remarks
	Yes	No	
Crate in sound condition			
Type number on insulator			
Number of sheds			
Live end fitting type			
Live end fitting size		mm	
Live end nuts, bolts, pins included			
Earth end fitting type			
Earth end fitting size		mm	
Earth end nuts, bolts, pins included			
Corona rings included			
Connecting length		mm	
Alternating sheds			
Shed diameter 1		mm	
Shed diameter 2		mm	
Core diameter		mm	
Galvanizing thickness		µm	
Shed material type			
Is crate damaged?			
Have all units been examined?			
Number of units rejected			
CRATE APPROVED FOR INSTALLATION			

Inspected by: ____________________________________

Signature: ____________________________________

Date: ____________________________________

Annex C - List of illustrations

(informative)

All photographs are illustrated below.

Photo 24: Tower attachment hardware that is not free to swing vertically.

Photo 25: Insulator without cardanic mobility at severe risk to bending stresses.

Photo 26: Exposure of the insulator core owing to rope damage of the sheath.

Photo 27: Loose corona ring that can inflict severe sheath damage.

Photo 28: Climbing on insulators may cause damage to sheath and sheds.

Photo 29: Conductor tensioning without proper swivel.

Photo 30: Conductors must be carefully handled to avoid the formation of kinks, twists and loops.

Photo 31: Insulators must be kept well out of the way when tensioning the conductor.

Photo 32: Pulling up string and conductor with come-along and avoiding stress on the insulator.

Photo 33: Insulator must be prevented from twisting when turnbuckles are tightened.

Photo 34: Cantilever breakage of line post insulator owing to incorrect stringing procedures.

Photo 35: Sheath damage causing critical exposure of the core. Note shed damage as well.

Photo 36: Splitting of line post sheath that will allow moisture ingress.

Photo 37: Displacement of un-bonded sheds and exposure of core because of improper stringing procedures.

Photo 38: Insulator suffering from critical damage to the end seal.

Photo 39: An example of on-site shed damage.

Photo 40: Split in rod and sheath owing to severe bending and, possibly, twisting of the insulator.

Photo 41: Marks on insulator end fittings indicating the application of non-tensile loads and possible abuse.

Photo 42: Line post insulator that has been fractured by overloading during stringing operations.

Photo 43: It must be ensured that all connecting bolts are fully tightened.

Photo A1: Mechanical failure of insulator owing to bending.

Photo A2: Internal electrical failure of insulator owing to core being split by bending.

Photo A3: Acid attack of glass fibre.

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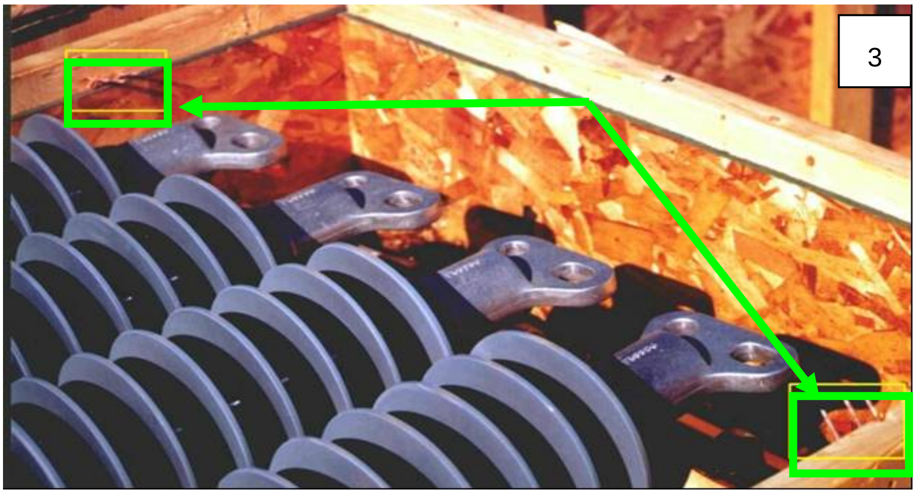
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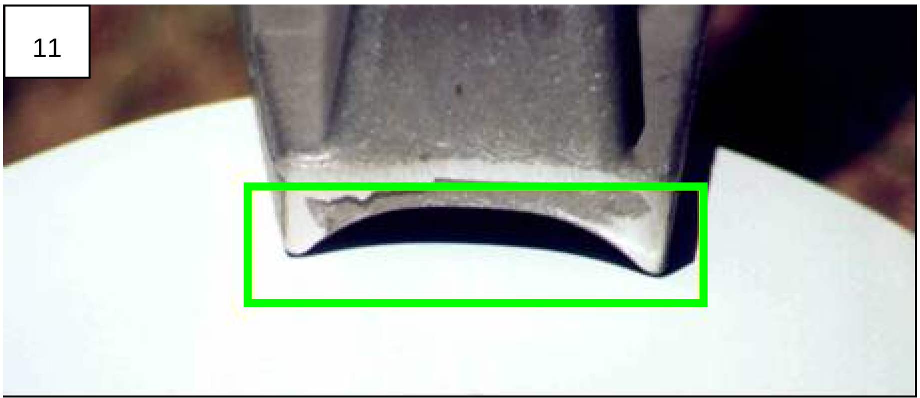
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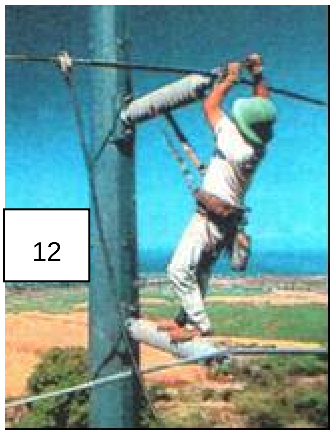
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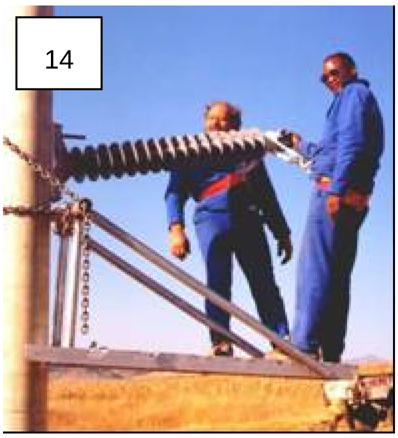
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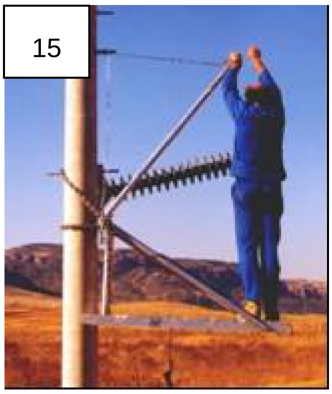
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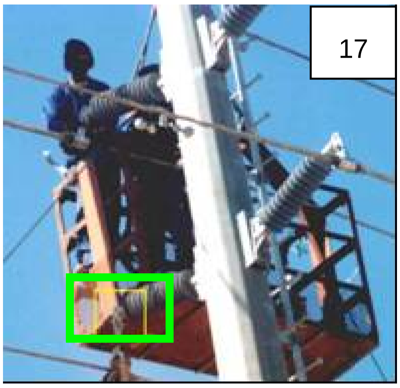
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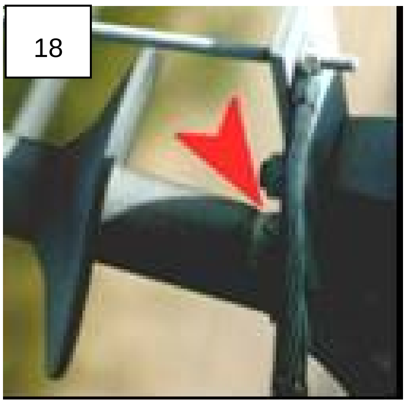
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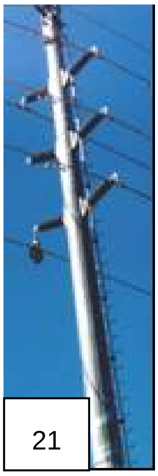
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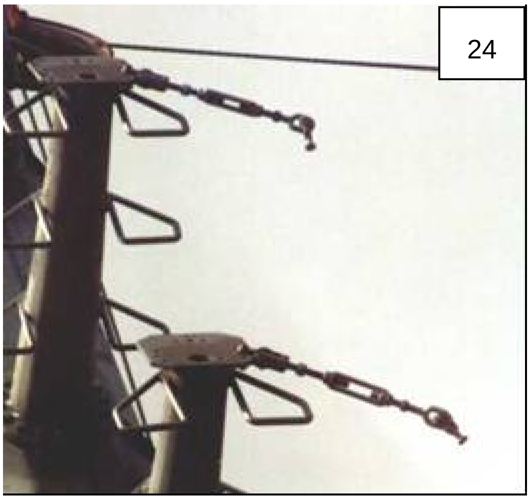
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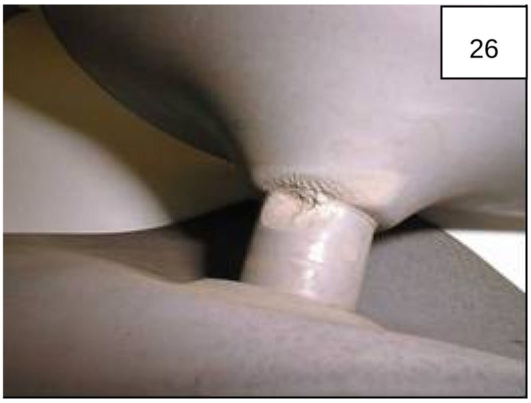
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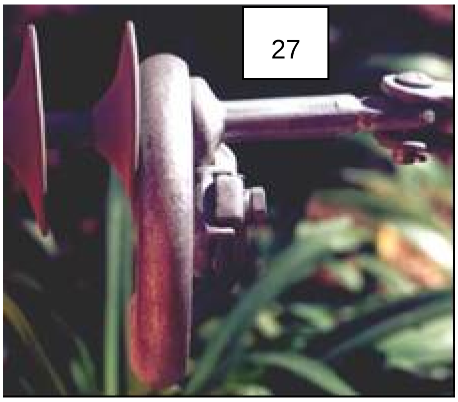
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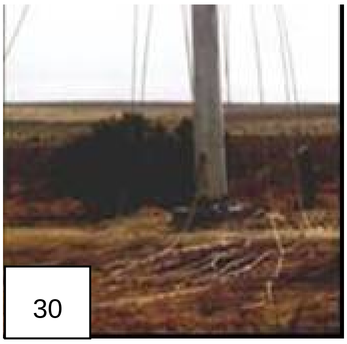
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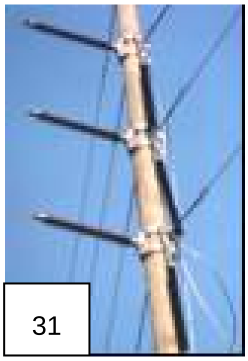
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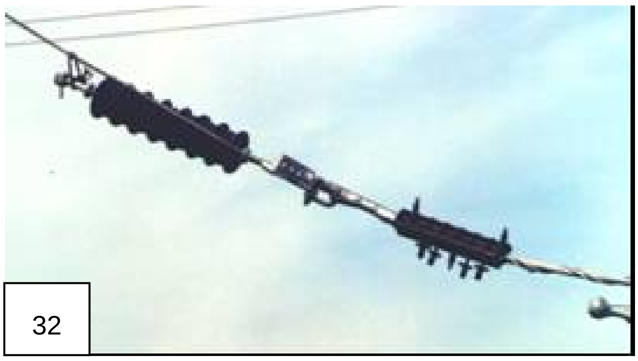
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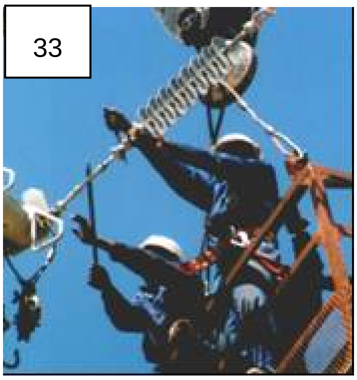
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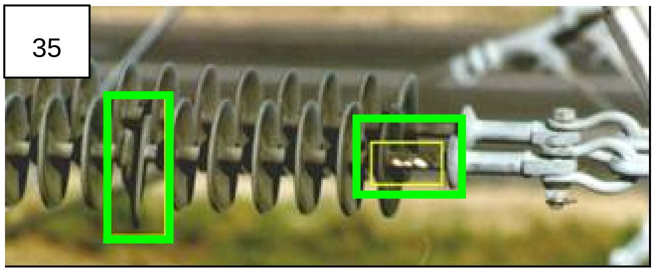
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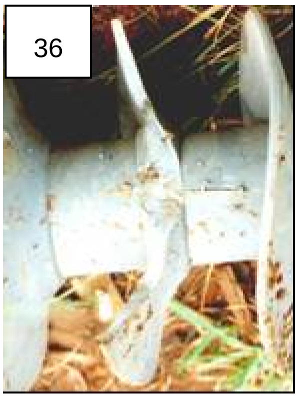
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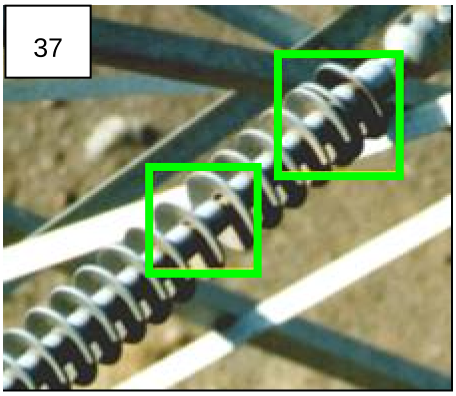
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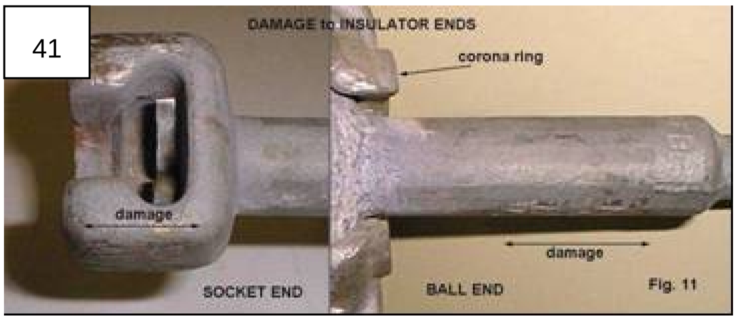

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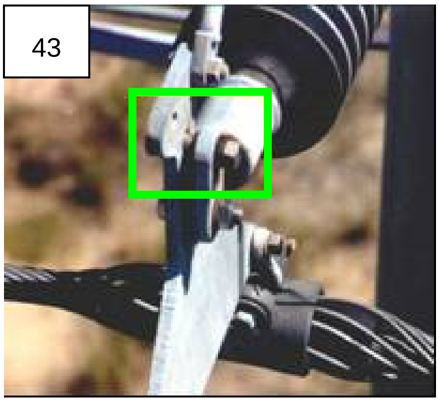
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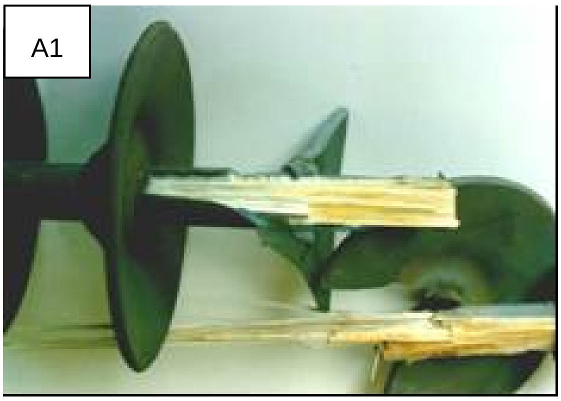
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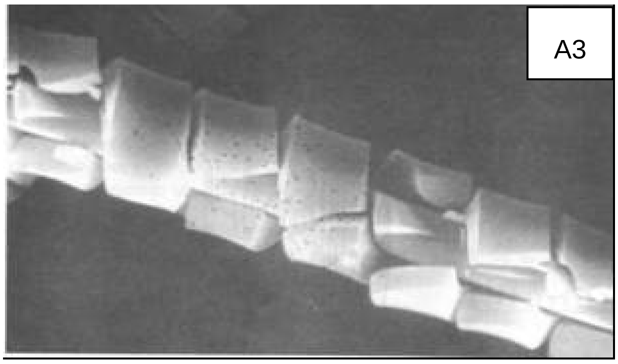
A3

Annex D – Impact Assessment

(Normative)

Impact assessment form to be completed for all documents.

1 Guidelines

- All comments must be completed.
- Motivate why items are N/A (not applicable)
- Indicate actions to be taken, persons or organisations responsible for actions and deadline for action.
- Change control committees to discuss the impact assessment, and if necessary give feedback to the compiler of any omissions or errors.

2 Critical points

2.1 Importance of this document. E.g. is implementation required due to safety deficiencies, statutory requirements, technology changes, document revisions, improved service quality, improved service performance, optimised costs.

Comment: Document was revised with no change in technical content. This standard is to be work shopped with all construction personnel working with insulators.

2.2 If the document to be released impacts on statutory or legal compliance - this need to be very clearly stated and so highlighted.

Comment: Not applicable.

2.3 Impact on stock holding and depletion of existing stock prior to switch over.

Comment: Not applicable.

2.4 When will new stock be available?

Comment: Not applicable.

2.5 Has the interchangeability of the product or item been verified - i.e. when it fails is a straight swop possible with a competitor's product?

Comment: Not applicable.

2.6 Identify and provide details of other critical (items required for the successful implementation of this document) points to be considered in the implementation of this document.

Comment: Not applicable.

2.7 Provide details of any comments made by the Regions regarding the implementation of this document.

Comment: (N/A during commenting phase)

Annex D
(continued)

3 Implementation timeframe

3.1 Time period for implementation of requirements.

Comment: Document was revised with no change in technical content. A continuous awareness campaign shall be driven on the content of this document.

3.2 Deadline for changeover to new item and personnel to be informed of DX wide change-over.

Comment: N/A

4 Buyers Guide and Power Office

4.1 Does the Buyers Guide or Buyers List need updating?

Comment: No

4.2 What Buyer's Guides or items have been created?

Comment: None

4.3 List all assembly drawing changes that have been revised in conjunction with this document.

Comment: None

4.4 If the implementation of this document requires assessment by CAP, provide details under 5

4.5 Which Power Office packages have been created, modified or removed?

Comment: Not applicable

5 CAP / LAP Pre-Qualification Process related impacts

5.1 Is an ad-hoc re-evaluation of all currently accepted suppliers required as a result of implementation of this document?

Comment: No

5.2 If NO, provide motivation for issuing this specification before Acceptance Cycle Expiry date.

Comment: This is a guideline and not a specification, hence no motivation is necessary.

5.3 Are ALL suppliers (currently accepted per LAP), aware of the nature of changes contained in this document?

Comment: No. There are no changes to technical content.

Annex D
(continued)

5.4 Is implementation of the provisions of this document required during the current supplier qualification period?

Comment: No

5.5 If Yes to 5.4, what date has been set for all currently accepted suppliers to comply fully?

Comment: N/A

5.6 If Yes to 5.4, have all currently accepted suppliers been sent a prior formal notification informing them of Eskom's expectations, including the implementation date deadline?

Comment: N/A

5.7 Can the changes made, potentially impact upon the purchase price of the material/equipment?

Comment: N/A

5.8 Material group(s) affected by specification: (Refer to Pre-Qualification invitation schedule for list of material groups)

Comment: N/A

6 Training or communication

6.1 Is training required? Yes

Comment: A continuous awareness campaign shall be driven on the content of this document.

6.2 State the level of training required to implement this document. (E.g. awareness training, practical / on job, module, etc.)

Comment: Awareness and on job training is required.

6.3 State designations of personnel that will require training.

Comment: T.O's, PTO's STO's, Senior Supervisors and TSO's in Field Services and all Construction personnel who build lines and substations for Eskom.

6.4 Is the training material available? Identify person responsible for the development of training material.

Comment: No. Francisca Mabuza from IARC training to ensure that training material is available.

6.5 If applicable, provide details of training that will take place. (E.G. sponsor, costs, trainer, schedule of training, course material availability, training in erection / use of new equipment, maintenance training, etc).

Comment: On the job training will take place and hence no additional costs involved. Training to extend to all types of insulators rated up to 132kV. This standard is to be work shopped with all construction personnel working with insulators.

Annex D
(continued)

6.6 Was Technical Training Section consulted w.r.t module development process?

Comment: Yes

6.7 State communications channels to be used to inform target audience.

Comment: Regional Change Control Committees.

7 Special tools, equipment, software

7.1 What special tools, equipment, software, etc will need to be purchased by the Region to effectively implement?

Comment: No new special tools and equipment are necessary.

7.2 Are there stock numbers available for the new equipment?

Comment: N/A

7.3 What will be the costs of these special tools, equipment, software? N/A

8 Finances

8.1 What total costs would the Regions be required to incur in implementing this document? Identify all cost activities associated with implementation, e.g. labour, training, tooling, stock, obsolescence?

Comment: The Guide has been revised and since there is no change in technical content, training will be ongoing. As such, no additional costs will be incurred by the Regions.

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…….

Impact assessment completed by:

Name: A.K Persadh

Designation: Senior Advisor - IARC