Eskom	Standard	Technology

Title: **ESKOM REQUIREMENTS FOR LOW VOLTAGE FUSE HOLDERS STANDARD**

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SCOT/SC Chairperson

Date: 13 Feb 2023

PCM Reference: **Perform High Voltage Plant Engineering Technical Studies**

SCOT Study Committee Number/Name: **<Number or name>**

Content

Figures

1. Introduction

This document consists of LV fuse holder standard.

2. Supporting Clauses

2.1 Scope

2.1.1 Purpose

This is a functional specification giving Eskom's particular requirements for a 400 V, 160 A outdoor fuse holder for use with aerial bundled conductor and a 400V, 400 A outdoor fuse holder for connecting copper LV cables to LV overhead lines.

2.1.2 Applicability

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 below (list the references 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.

2.2.1 Normative

[1] BS EN ISO 4892-3, Plastics Methods of exposure to laboratory light sources - Fluorescent UV lamps

[2] IEC 60695-2-1:1991, Fire hazard testing Part 2: Test methods Section 1: Glow wire test and guidance.

[3] IEC 60817:1984, Spring-operated impact-test apparatus and its calibration.

[4] SANS 9227, Corrosion tests in artificial atmospheres - Salt spray tests

[5] SANS 60947-1: Low voltage switchgear and controlgear Part 1: General rules.

[6] SANS 60947-3: Low voltage switchgear and controlgear, Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units.

[7] SANS 60269-1: Low voltage fuses Part 1: General requirements.

[8] SANS 60269-2: Low voltage fuses Part 2: Supplementary requirements for fuses for uses by authorized persons (fuses mainly for industrial application).

[9] SANS 1433-1, Terminal blocks having screwed and screwless terminals

[10] Eskom drawing D-DT-0309, MV reticulation: SANS 780 transformers and LV fuse holder connections

2.2.2 Informative

None

2.3 Definitions

2.3.1 General

For the purpose of this specification, the definitions given in SANS 60947-3 shall apply

2.3.2 Disclosure classification

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

2.4 Abbreviations

For the purpose of this specification abbreviations given in SANS 60947-3 shall apply

2.5 Roles and Responsibilities

The relevant sections within Eskom Distribution are responsible to implement the new design according to the requirements as listed in this document.

2.6 Process for monitoring

Adherence to this document shall be monitored through routine inspections

2.7 Related/Supporting Documents

Not applicable.

3. Requirements

3.1 Eskom Requirements for Low Voltage Fuse Holders

3.1.1 General

The fuse holder shall comply with the requirements of SANS 60947-3. Additional requirements are listed in this document.

3.1.1.1 Climatic conditions

The installation of fuse holders may be required where the following climatic conditions prevail:

a) Ambient air temperatures:

- Maximum 45 °C
- Minimum–15 °C
- Average daily mean 25 °C

b) Altitude up to 1800 m above sea level

c) Lightning conditions, severe — up to 14 strikes/km2/year

d) Atmospheric conditions:

- Coastal: Humid up to 90 % relative humidity at 30 °C, saline, dusty, pollution degree 3 as defined SANS 60947-1.
- Inland: Dry, dusty, pollution level 3 as defined by SANS 60947-1.

e) Prolonged exposure to solar radiation

3.1.1.2 Characteristics

The fuse holder shall comply with SANS 60947-3. The specific characteristics are as follows:

Classification:	fuse-switch-disconnector
Utilization category:	AC 22 B

Operation:	Dependent Manual Operation
Suitability for isolation:	Suitable for isolation
Degree of protection:	IP23
Poles:	1 pole
Rated Operation Voltage, Ue:	400 V
Rated Insulation Voltage, Ui:	1000 V
Rated Impulse Voltage, Uimp:	12 kV
Rated Operational Current, Ie:	160 A / 400A per phase fused
Conventional free air thermal current, Ith:	= Ie
Rated making and breaking capacity, I & Ic	= 3 x Ie
Rated frequency:	50 Hz
Rated duty:	Uninterrupted
Rated conditional short-circuit current (fuse-protected short-circuit withstand and fuse-protected short circuit making): ISC	12 kA

3.1.2 Construction

3.1.2.1 The fuse holder shall consist of two parts:

The upper housing, with integral mounting facility, which shall contain the conductor terminals and fuse contacts; and the lower, detachable, hinged housing which shall contain the fuse links.

a) The fuse holder shall preferably be constructed so that the conductor slopes downward away from the fuse holder.

b) The fuse holder shall preferably have holes for drainage.

c) The fuse holder shall preferably consist of two parts only. Additional removable hoods and/or covers are not preferred. They are acceptable only if they are permanently attached to the upper housing (e.g. by means of a cable-tie arrangement).

d) The fuse holder shall have a life of at least 15 years, under the conditions described in 3.1.1.1. The manufacturer shall state which special steps have been taken to ensure this life, especially with regard to chemical pollutants. The fuse holder housing material shall show no signs of ultraviolet degradation when tested in accordance with 3.2.7.

e) Precautions shall be taken to ensure that no accidental electrical connection can arise between the external conductive parts of the fuse holder and a live conductor.

3.1.3 Disassembly

a) It shall be possible to open the fuse holder, remove and replace the lower housing using a link stick with a standard disconnect attachment.

b) Steps shall be taken to ensure ease of opening, removal and replacement of the lower housing (see Annex B).

c) The closed and open positions of the unit shall be clearly visible from ground level with the unit mounted at 9 m above ground.

d) Each unit shall come with a “fuse-blown” indicator. This indicator shall take the form of a light that comes on only when the fuse has blown. This light shall be installed in the lower housing of the fuse holder, so that it faces downwards (towards the ground) when the fuse holder is mounted on a pole.

3.1.4 Electrical/ functional

a) Two types of units may be required: either 160 A single-pole units or 400 A single-pole units.

b) The 160 A fuse holder shall accept a type NH00 fuse, with a maximum current rating of 160 A, in accordance with IEC 60269, DIN 43620 and VDE 0636. The 400 A fuse holder shall accept a type NH2 fuse, with a maximum current rating of 400 A, in accordance with IEC 60269, DIN 43620 and VDE 0636.

c) All metallic parts of the fuse holder shall be such that they are electrochemically compatible

- with each other and
- with the contacts of the fuse link that may be nickel or tin or silver plated and
- with aluminium conductor connected to the terminals (for the 160 A units) or
- with copper conductor connected to the outgoing terminals and ACSR conductor connected to the incoming terminal (for the 400 A units).

The fuse holder shall pass the temperature rise test and overload tests specified in SANS 60947-3, as described in 3.2.1. The watt loss of the fuse element with the highest watt loss used for these tests shall be clearly and permanently marked on the fuse holder. This value will be considered to be the maximum watt loss that a fuse link may have and still be acceptable for use with the fuse holder.

3.1.5 Terminal/connectors

a) The terminals shall be of a standard screw-in pillar type. Clause 8.2.4 of SANS 60947-1 shall apply to the 400 A units but not to the 160 A units. The terminals for the 160A units shall accept aluminium conductors from 16 mm2 to 70 mm2. See drawing D-DT-0309 for the intended connection schematic. The terminals for the 400 A units shall accept copper conductors from 70 mm2 to 185 mm2 on the outgoing terminals and a ACSR conductor in the range from Fox up to Hare on the incoming terminal.

b) Screw-in pillar type terminals shall comply with the requirements of SANS 1433-1.

c) The terminals shall have anti-corrosive properties to withstand the conditions specified in 3.1.1.1.

d) Where 2 bolts are used, the order or method of tightening shall not be detrimental to the terminal.

e) The terminals' bolts shall have a standard hexagonal head. The bolts shall be accessible (when the unit is open) using a standard ring or tube spanner. M13 bolt heads are preferred.

f) It shall not be possible to insert the conductor too far into the unit such that it interferes with the fuses.

g) There shall be one incoming and two outgoing terminals on the 160 A units. The 400 A units shall have one incoming and two outgoing terminals.

3.1.6 Fire resistance

The fuse holder shall ensure reasonable safety against the spread of fire. It shall not be ignited by thermal overload or by contact with a live, bare conductor. When the fuse holder is tested in accordance with 3.2.2, any flame shall die within 5 s of the glow wire being removed from the fuse holder.

3.1.7 Resistance to impact

When tested in accordance with 3.2.5, the fuse holder shall show no damage that may be detrimental to its continued use.

3.1.8 Resistance to solvents/environmental corrosion

a) The fuse holder shall be constructed from a material or materials that have an acceptable resistance to weathering.

b) When the fuse holder is tested in accordance with 3.2.6, it shall show no signs of corrosion:

- due to interaction between any of the metals used in the fuse holder and the environment, or
- due to the interaction between dissimilar metals in the fuse holder itself, or
- due to the interaction between dissimilar metals in the fuse holder and the fuse link or
- due to the interaction between dissimilar metals in the fuse holder and the conductor connected to the terminals.

3.2 Tests

3.2.1 General Tests

a) For fuse holders, which are made from non-conductive material, the metallic mounting bracket shall be considered the 'frame of the equipment'.

b) All tests specified in SANS 60947-3 for fuse-switch disconnectors shall apply, with the following modifications:

- Routine tests (8.1.3) are not usually required.
- Sampling tests (8.1.4) are not usually required.
- Special tests (8.1.5 and 8.5) are not required.

c) The tests for constructional requirements (8.2) shall be carried out with the following modifications:

- The tests specified in 8.2.1 of SANS 60947-1 (referenced in SANS 60947-3) shall be replaced with the tests specified in 3.2.2 below.
- The tests specified in 8.2.3 of SANS 60947-1 (referenced in SANS 60947-3) shall be done in accordance with the requirements of 3.2.3 below.
- The tests specified in 8.2.4 of SANS 60947-1 (referenced in SANS 60947-3) may only apply to the outgoing terminals of the 400 A unit only (if the terminals are not made of aluminium) and not to the incoming terminal of the 400A unit and all the terminals of the 160 A unit (as the conductors that will be used in the latter cases are aluminium). The tests specified in 3.2.4 below shall be carried out on all terminals.

The tests specified in 8.2.5 of SANS 60947-3 and 8.2.7 of SANS 60947-1 (referenced in SANS 60947-3) are not applicable.

- The performance tests (8.3 – general performance, operational performance, conditional short circuit current and overload performance) shall be carried out with the following modifications:

d) The temperature rise test for the 160 A unit (clause 8.3.3.1 in SANS 60947-3) and the overload test (clause 8.3.7.1 in SANS 60947-3) shall be carried out using 2 m lengths of 70 mm2 aerial bundled conductor (ABC) connected to each side of the unit. The test shall be carried out with a 160 A fuse link. The power loss of the fuse link used will be deemed to be the maximum power loss that a fuse link may have and still be acceptable for use with the fuse holder. Conventional thermal current is assumed to be IR (160 A).

e) The temperature rise test for the 400 A unit (clause 8.3.3.1 in SANS 60947-3) and the overload test (clause 8.3.7.1 in SANS 60947-3) shall be carried out using 2 x 2 m lengths of 70 mm2 copper cable connected to the outgoing side of the unit and 1 x ACSR Wolf conductor on the incoming side of the unit. The test shall be carried out with a 400 A fuse link. The power loss of the fuse link used will be deemed to be the maximum power loss that a fuse link may have and still be acceptable for use with the fuse holder. Conventional thermal current is assumed to be IR (400A).

- Electromagnetic compatibility (8.4 of SANS 60947-3) tests are not required.

3.2.2 Resistance to abnormal heat and fire

The test in accordance with IEC 60695-2-1 shall be carried out using a temperature of 650 °C ± 10 °C. The glow wire shall be applied to any random location on the fuse holder for a period of 30 s ± 1 s. This test replaces the tests specified in clause 8.2.1 of SANS 60947-1.

3.2.3 Tests for degree of protection

The fuse holder shall be tested to verify the degree of protection of enclosed equipment (IP rating) in accordance with SANS 60947-1 refers to annex C. The 160 A unit shall be connected to an aerial bundled conductor and energized as for normal use for the purposes of the protection rating test (IP23 in accordance with SANS 60947-1 Annex C and IEC 60529),. There shall be no water ingress to the aerial bundled conductor. The 400 A unit shall be connected to a 185 mm2 single core copper LV cable on the outgoing side and a ACSR Hare conductor on the incoming side and energized as for normal use for the purposes of the protection rating test (IP23 in accordance with SANS 60947-1 Annex C and IEC 60529). There shall be no water ingress to the cable.

3.2.4 Additional tests on terminals

Where pillar type terminals are used, the following tests in accordance with clause 6 of SANS 1433-1 shall be carried out:

a) Clause 6.4 – Conductor fit

b) Clause 6.6 – Damage to conductors by clamping means

c) Clause 6.7 – Firmness of clamping

d) Clause 6.8 – Firmness of attachment of terminal to support

The maximum conductor size for these tests shall be as follows:

a) 160 A unit : 70 mm2 aluminium, and

b) 400 A unit: 185 mm2 copper for the outgoing terminals and ACSR Hare for the incoming terminal.

3.2.5 Resistance to impact

Each surface of the fuse holder that is apparently weak, or that appears liable to damage in normal use, shall be subjected to one blow of an impact hammer, applied at right angles to the surface. An impact hammer described in IEC 60817 shall be used, set to deliver an impact energy of 0,5J ± 0,05J.

3.2.6 Resistance to Corrosion

A 1000-hour salt-spray corrosion test in accordance with ISO 9227 (or equivalent e.g. SANS 50483) shall be accepted.

a) The 160 A fuse holder shall be tested with a 300 mm long section of 70 mm2 bare aluminium conductor connected to each terminal.

b) The 400 A fuse holder shall be tested with a 300 mm long section of 185 mm2 bare copper conductor connected to each outgoing terminal and a 300 mm long section of ACSR Hare conductor connected to the incoming terminal.

c) Three samples of each fuse holder size (160 A and 400 A) shall be tested. The first of each type shall be tested with a fuse link with nickel plated contacts fitted, the second shall be tested with a fuse link with tin plated contacts fitted and the third shall be tested with a fuse link with silver plated contacts fitted.

The fuse holder will be deemed to have passed the test if no corrosion is visible on any of the metal surfaces of any of the three samples of the fuse holder under test. There shall be no visible corrosion on the metal surfaces of the fuse link.

3.2.7 Resistance to ultra-violet (UV) radiation

An ultra-violet (UV) withstand test in accordance with EN ISO 4892-3 (or equivalent) shall be successfully carried out on the fuse holder.

3.3 Marking

The fuse holder shall clearly be marked “IN” at the supply side and “OUT” at the load side. This requirement is in addition to the markings required by SANS 60947-3

4. Authorisation

Name and surname	Designation
Jutas Maudu	Senior Engineer
Mfundi Songo	Senior manager HV Plant
Andreas Beutel	MV/LV SC chairperson

5. Revisions

Date	Rev	Compiler	Remarks
Sept 2022	Draft 2.1	Jutas Maudu	Document due for revision Glowire test updated References updated (SANS 60947) NRS 018 removed Technical schedule updated
March 2017	2	Jutas Maudu	Document content transferred from old template to latest SCOT template, no technical changes on the document
Feb 2014	1	Jutas Maudu	No change in content, change in format only. This document supersedes document DSP_34-255
Dec 2001	1	T Gillard	Compiled By: T Gillard • 400 amp fuse holder added. • Corrosion resistance tests added. • Overload tests added.
Nov 1995	0	P Nowosad	Original issue of DISSCAAH6

6. Development team

- Jutas Maudu
- Masithembe Ngcwama
- Shalen Goonoa

7. Acknowledgements

Not applicable.

Annex A – Impact Assessment

1 Guidelines

- All comments must be completed.
- Motivate why items are not applicable (n/a).
- Indicate actions to be taken, persons or organizations responsible for actions and deadline for action.
- Change control committees to discuss the impact assessment and, if necessary, give feedback to the compiler regarding 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, optimized costs.

Comment: document revisions

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

Comment: n/a

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

Comment: n/a

2.4 When will new stock be available?

Comment: As soon as the specification is published.

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

Comment: Straight swap.

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: n/a

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

Comment: only during commenting phase.

3 Implementation Time Frame

3.1 Time period for implementation of requirements.

Comment: When specification is available.

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

Comment: n/a

4 Buyer's Guide and Power Office

4 1 Does the Buyer's Guide or Buyer's List need updating?

No

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

None

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

Comment: n/a

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

Comment. N/A

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

Comment: n/a

5 Training or Communication

5.1 Is training required?

Comment: No.

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

Comment: n/a

5.3 State designations of personnel that will require training.

Comment: n/a

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

Comment: n/a

5.5 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).

Comment: N/A

5.6 Was Technical Training Section consulted regarding module development process?

Comment: n/a

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

Comment: n/a

6 Special Tools, Equipment, Software

6.1 Special tools, equipment, software, etc. will need to be purchased by the Region to effectively implement?

Comment: None.

6.2 Are stock numbers available for the new equipment?

Comment: n/a

6.3 What will be the cost of these special tools, equipment, software?

Comment: 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: N/A

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Impact assessment completed by:

Name: Jutas Maudu

Designation: Senior Engineer

Annex B – Drawing

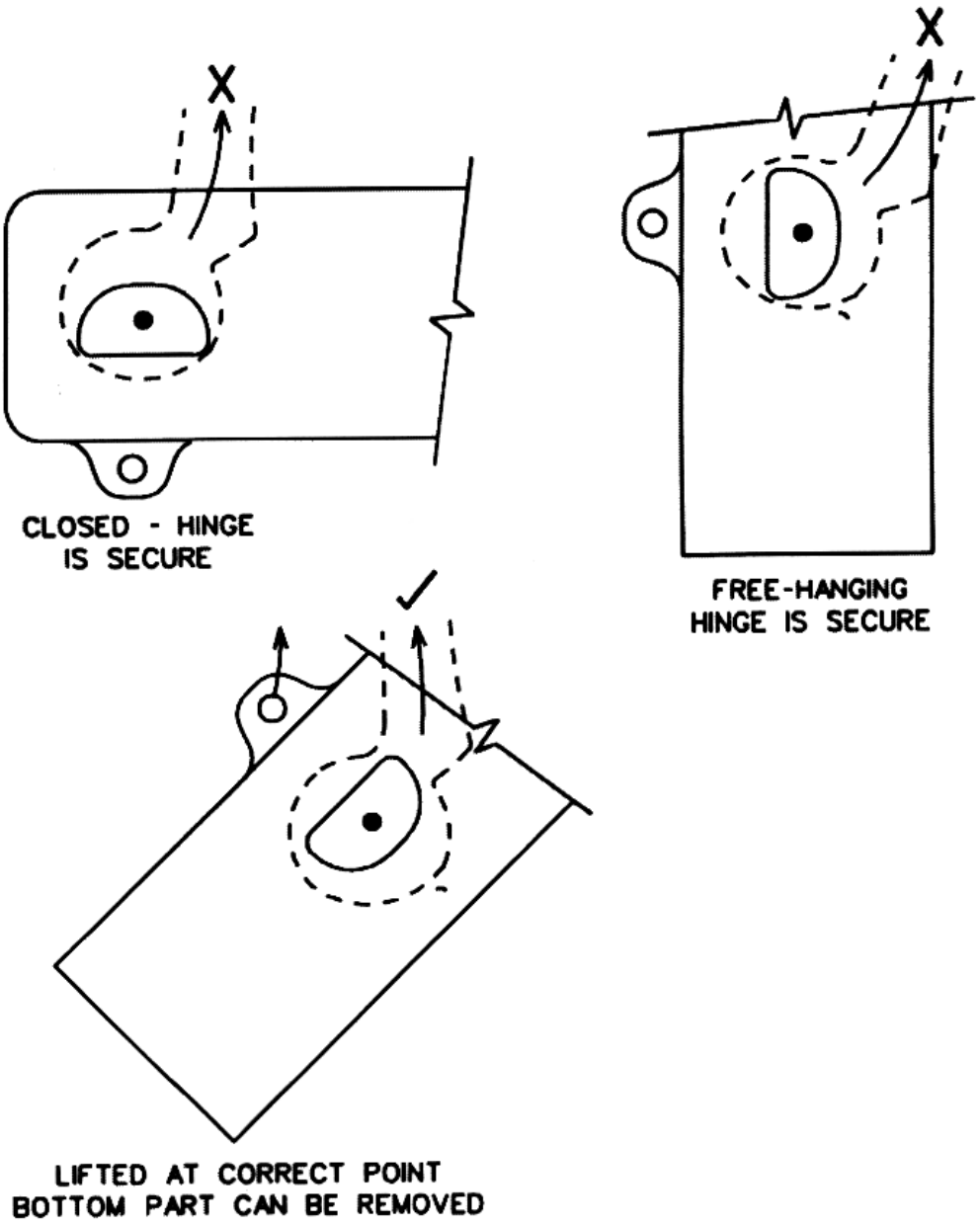

Figure B.1: Example of design facilitating easy removal of bottom part, while minimizing the risk of unintentional separation

Annex C – Technical Schedules A and B

Eskom requirements for low voltage fuse holders

Schedule A: Purchaser's specific requirements

Schedule B: Particulars of equipment to be supplied

1	2	3	4	5
Item	**Clause**	**Description**	**Schedule A**	**Schedule B**
1	3.1.1	Does the fuse holder comply with SANS 60947-3 and additional requirements listed in 240-75660476?		
3.1.1.1 Climatic conditions:				
2	a)	Does the fuse holder comply with ambient air temperatures listed in 240-75660476?	Yes	
3	b)	Altitude above sea level.	1800m	
4	c)	Does the fuse holder withstand lightning conditions up to 14 strikes/km2/year?	Yes	
5	d)	Does the fuse holder withstand atmospheric conditions listed in 240-75660476?	Yes	
6	e)	Prolonged exposure to solar radiation.	Yes	
3.1.1.2 Characteristics:				
7		Does the fuse holder comply with all specific characteristics?	Yes	
3.1.2 Construction:				
8		Is the fuse holder consisted of two parts? The upper housing and the lower, detachable, hinged housing.	Yes	
9	a)	Is the fuse holder constructed in such a way that the conductor slopes downward away from the fuse holder?	Yes	
10	b)	Does the fuse holder have holes for drainage?	Yes	
11	c)	Does the fuse holder have any additional removable hoods or covers?		
12	d)	Fuse holder shall have a life cycle of at leas 15 years. Are special steps taken to ensure this life provided?	Yes	
13	e)	Precautions shall be taken to ensure that no accidental electrical connection can arise between the external conductive parts of the fuse holder and a live conductor.	Yes	

3.1.3 Disassembly:				
14	a)	Is it possible to open the fuse holder, remove and replace the lower housing using a link stick with a standard disconnect attachment?	Yes	
15	b)	Are the steps in Annex B taken to ensure ease of opening, removal and replacement of the lower housing?	Yes	
16	c)	Are the closed and open positions of the unit clearly visible from ground level with the unit mounted at 9 m above ground?	Yes	
17	d)	Does the fuse holder have a fuse-blown indicator? Does the indicator face downwards i.e. towards the ground?	Yes	
3.1.4 Electrical or functionality:				
18	a)	Two types of units	Either 160A or 400A single-pole unit	
19	b)	160A fuse holder shall accept NH00 fuse and 400A fuse holder shall accept NH2.	Yes	
20	c)	Are all metallic parts of the fuse holder electrochemically compatible with the following? each other contacts of the fuse link aluminium conductor copper conductor	Yes	
21		Did the fuse holder pass temperature rise and overload tests? Is the watt loss clearly marked on the fuse holder?	Yes	
3.1.5 Terminal or connectors:				
22	a)	Are the terminals standard screw-in pillar type? Do the terminals for 160A fuse holder accept Al conductors from 16 mm2 to 70 mm2? Do the terminals for 400A fuse holder accept Cu conductors from 70mm2 to 185mm2 on the outgoing terminals and ACSR conductors on incoming terminal?	Yes Yes Yes	
23	b)	Does screw-in pillar type comply with SANS 1433-1?	Yes	
24	c)	Do terminals have anti-corrosive properties?	Yes	
25	d)	Are two bolts used? If yes, is the method of tightening not detrimental to the terminal?		
26	e)	Are terminal bolts having stranded hexagonal heads? Are M13 bolt heads used?		
27	f)	It shall not be possible to insert the conductor too far into the unit such that it interferes with the fuses.	Yes	
28	g)	There shall be one incoming and two outgoing terminals for both 160A and 400A fuse holders.	Yes	

3.1.6 Fire Resistance:				
29		Are the proofs of open flame and glow wire tests provided?	Yes	
3.1.7 Resistance to impact:				
30		Resistance to impact done in accordance with IEC 60817.	Yes	
3.1.8 Resistance to solvents/environmental corrosion:				
31	a)	Fuse holder constructed with materials that have an acceptable resistance to weathering.	Yes	
32	b)	When the fuse holder is tested in accordance with 3.2.6, it shall show no signs of corrosion: • due to interaction between any of the metals used in the fuse holder and the environment, or • due to the interaction between dissimilar metals in the fuse holder itself, or • due to the interaction between dissimilar metals in the fuse holder and the fuse link or • due to the interaction between dissimilar metals in the fuse holder and the conductor connected to the terminals.	Yes	
33	3.3	The fuse holder shall clearly be marked “IN” at the supply side and “OUT” at the load side. This requirement is in addition to the markings required by SANS 60947-3	Yes	