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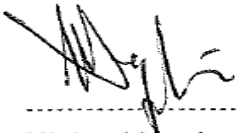
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Compiled by



Michael Ngubane

Senior Technologist  
Transformers and Reactors

Date: 30/01/2018

Approved by

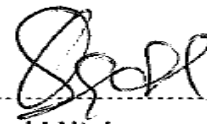


Sidwell Mtetwa

Corporate Specialist  
Transformers and Reactors

Date: 30/01/2018

Authorized by



Bheki Ntshangase

Senior Manager HV Plant  
Engineering

Date: 31/1/2018

Supported by SCOT/SC



Bheki Ntshangase  
SCOT/SC Chairperson

Date: 31/1/2018

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## **1. Introduction**

Each conservator tank (main tank and OLTC) shall be provided with a dial-type oil level indicator that will show the correct oil level inside the tank. Direct reading fluid type oil level indicators shall not be used.

The indicators shall be suitable for the design of the conservator, i.e. free-breathing or air-cell type conservators.

Expected design life of the oil level indicator shall match the design life of a transformer, at least 40 years.

## **2. Supporting clauses**

### **2.1 Scope**

This specification covers the technical requirements for the selection and purchase of oil level indicators fitted to Transformers and Reactors. The purpose of this document is to ensure that the requirements of these indicators are standardised within Eskom during the procurement stage.

This document shall be used as a minimum requirement for the purchase and selection of oil level indicators fitted to transformers and reactors.

- Oil level indicators fitted to new Transformers and Reactors
- Oil level indicators fitted to in-service Transformers and Reactors
- Oil level indicators purchased as Spare Parts

#### **2.1.1 Purpose**

This document was produced in order to record the standardized requirements that shall be applied across-divisional Transmission, Generation and Distribution.

#### **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 in the following paragraphs.

### **2.2.1 Normative**

[1] ISO 9001, Quality Management Systems.

### **2.2.2 Informative**

None

## **2.3 Definitions**

### **2.3.1 General**

None

### **2.3.2 Disclosure classification**

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

## 2.4 Abbreviations

Abbreviation	Description
°C	Degrees Celsius
ID	Internal diameter
kV	Kilo volts
L	Litres
mm	Millimetre
MVA	Mega Volt Ampere
OD	Outside diameter
UV	Ultra violet

## 2.5 Roles and responsibilities

Not applicable.

## 2.6 Process for monitoring

Not applicable.

## 2.7 Related/supporting documents

Not applicable.

## 3. Requirements

### 3.1 General

The oil level gauge shall be mounted on the side of the conservator tank. Installation and removal of the complete gauge with float and float-arm shall be possible without having to remove the conservator end cover. The indicator shall be mechanically separated from the transmitter, i.e. magnetically coupled.

Once installed the indicator casing shall withstand the effects of full vacuum at sea level and provide effective sealing at air pressure of 100 kPa. The vibration of the transformer shall not produce wear and damage to the mechanism of the indicator.

Mechanical stoppers shall be provided on the indicator casing to prevent the float arm from travelling past minimum and maximum positions. The float arm length shall be adjustable to allow for different conservator tank sizes.

The complete casing shall be ventilated and have a protection class of IP55. Nitrile rubber shall be used as sealing material for "O" rings and flat rubber seals.

### 3.2 Environmental Conditions

Outdoor installation

Altitude above sea level – 1800 m

Ambient temperatures

- Maximum + 40°C
- Monthly average + 28°C

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- Yearly average + 25°C
- Minimum – 10°C

Average relative humidity 90%

Solar radiation 2500 W/m<sup>2</sup>

Atmospheric UV radiation - High

Seismic conditions at a maximum of 3g

Pollution level – High marine and industrial (C5-M)

### **3.3 Corrosion Protection**

Corrosion shall be eliminated by the use of non-corrodible materials, and by avoiding the contact of dissimilar metals. Where cast components are used they shall be of high quality and non-porous castings. Bare metal or aluminium castings shall be epoxy powder coated (exterior grade) or anodised.

Fasteners used shall be metric hexagon or Allen key type. All fasteners shall be stainless steel – grade 304 is acceptable. Electro galvanising or electro plating of parts and fasteners is not acceptable.

Corrosion protection used shall be suitable for use in high marine and industrial polluted environments with a C5-M classification.

Adequate lubrication shall be applied to all threaded areas of bolts, studs and screws. Any good quality high temperature grease may be used.

### **3.4 Flange and indicator dimensions**

Oil level indicators and flange dimensions shall be based on the voltage rating of the equipment. On-load tap changers shall be fitted with oil level indicators similar in size used on the transformers with voltage ratings of 66 - 132 kV.

Auxiliary transformer, NEC's and NER's (NECRT) shall be fitted with oil level indicators with dimensions as per Section 3.4.3.

#### **3.4.1 Transformers and Reactors > 132 kV**

Flange OD 220 mm  
Bolt PCD 190 mm  
Bolt holes 8 x 12 mm holes  
The float arm length 1000 mm adjustable

#### **3.4.2 Transformers and Reactors 33 - 132 kV and On-Load Tap changers**

Flange OD 140 mm  
Bolt PCD 125 mm  
Bolt holes 6 x 8 mm holes  
The float arm length 500 mm adjustable

#### **3.4.3 Transformers and Reactors 11 - 22 kV**

Flange OD 100 mm  
Bolt PCD 85 mm  
Bolt holes 4 x 8 mm holes  
The float arm length 200 mm adjustable

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### 3.5 Float and Float Arm

The operating arrangement of the float arm shall be axial for free breathing transformers and longitudinal for conservator tanks fitted with air-cells.

For transformers fitted with air-cells the floats shall freely rotate at 90° in relation to the float arm. Securing brackets for the floats shall not present any sharp edges.

The buoyancy of the floating elements shall be due to their specific gravity and shall not depend on the sealing of a hollow float. The floats shall not absorb oil if punctured. The float material shall not be affected by hot transformer oil.

The float arm shall have sufficient rigidity to accurately reflect the correct oil level. Float arms shall be manufactured from aluminium tubing or similar where the length of the arm exceeds 500 mm.

### 3.6 Gauge Glasses

Tempered glass shall be used as the only acceptable gauge glass material. No printing or stickers shall be allowed on the gauge glass.

### 3.7 Range of indication

The oil level indication shall be continuous over the range of top oil temperature from -10°C to +110°C.

The level of oil in the conservator corresponding with the 0°C index shall be not less than 25 mm above the transformer feed pipe entry. Maximum oil level shall be reached at a temperature of +110°C. The maximum oil levels shall be reached before oil is forced into the breather pipe, for free breathing units, or before the air-cell is completely compressed, in units fitted with oil preservation systems.

### 3.8 Graduation of Indicator

#### 3.8.1 Transformers and reactors (33 kV and above)

Dials shall be marked "Min" and "Max" for the respective levels. Indicator pointer shall move from empty to full in the clockwise direction. A dial shall be mounted behind the pointer to indicate the different temperature values. The dial shall be permanent marked and fade resistant. Stick-on labels shall not be used. No printing or stickers is allowed on the gauge glass.

Graduations, indicating the normal oil levels from empty (No 0) to full (No 10), shall be indicated on the dial in single equally spaced steps. The actual temperature values should not appear on the oil level indicator, which should bear only clear index marks at the specified points.

A table or curve correlating the index marks with their corresponding temperature values shall appear on the rating and diagram plate or on a similar plate affixed adjacent to it.

#### 3.8.2 Transformers and reactors (11 – 22 kV)

Dials shall be marked "Min" and "Max" for the respective levels. Indicator pointer shall move from empty to full in the clockwise direction. A dial shall be mounted behind the pointer to indicate the different temperature values. The dial shall be permanent marked and fade resistant. Stick-on labels shall not be used. No printing or stickers is allowed on the gauge glass.

Graduations, indicating the normal oil levels at -10°C, 20°C, 50°C, 85°C and 110°C, shall be indicated on the dial where -10°C shall be at Min and 110°C shall be at Max.

### 3.9 Alarm signalling and termination boxes

Two normally open micro switches shall be provided, one for signalling the min oil level and one for the maximum oil level. Micro switches shall be pre-set and rated for 0.25 A at 220 V DC. Min oil level micro switch shall close at -10°C and the maximum at +110°C.

The indicator circuits shall withstand an applied voltage of 2 kV DC for a duration of 60 seconds, applied in turn, between each electrically independent circuit and the casing of the gauge, and between the separate independent electrical circuits.

A suitable watertight and weather resistant electrical conduit threaded cable entry shall be provided. Each instrument shall be provided with at least 1 compression type gland for fitting of control wiring. Stoppers shall be provided to block the glands when not in use.

Terminal boxes shall be mounted to allow cable entry from the side or the bottom – cable entry from the top is not acceptable. Terminal boxes shall have an IP 55 rating. Fasteners used shall be metric hexagon or Allen key type.

Terminal boxes and terminal strips shall allow sufficient space for fitting and securing of 2,5 mm control wiring and cabling. Termination strips shall be numbered and basic wiring diagrams shall be provided inside the lid of the terminal box and in the installation instructions.

The units contacts shall be cabled to the Marshalling Kiosk by means of steel wired armoured cabling that is heat, oil and UV resistant.

All terminal boxes shall be provided with an earth connection point and shall be effectively earthed.

**Note:** No micro-switches or terminal boxes are required for units with a primary voltage of up to 22 kV.

### 3.10 Packing and documentation

Each oil level indicator shall be individually packed inside a cardboard box. The relay shall be securely packed and protected against damage and moisture ingress during shipping and storage.

Original and fully detailed instructions for assembly, wiring and maintenance shall be included.

## 4. Technical Evaluation and Final Approval

The OEM / Supplier shall be responsible to supply an oil level gauge for technical evaluation. The equipment shall be supplied to Eskom and will be subjected to destructive testing. The sample shall be supplied in accordance with this specification and it will remain the property of the supplier.

This specification serves as a minimum requirement for manufacturers that supplies oil level indicators. Any deviation from this specification has to be approved by Eskom in writing.

Final written approval shall be provided once a technical evaluation has been completed and equipment found in compliance with this specification and Eskom requirements.

Any changes to the approved product will be subjected to re-evaluation and approval.

## 5. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Sidwell Mtetwa	Corporate Specialist – (Transformers and Reactors, Chairman of Transformers and Reactors equipment care group HV PDE).
Khayakazi Dioka	Corporate Specialist (Transformers and Reactors HV PDE)
Lionel Jordaan	Senior Consultant (Transformers ) GX
Nkosinathi Buthelezi	Senior Consultant (Transformers and Reactors HV PDE)
Calvin Bongwe	Senior Technologist (Northern grid)
Andries Smit	Senior Advisor (Western grid)
Wessel Benecke	Work Manager (Rotek)

<b>Name and surname</b>	<b>Designation</b>
Phuti Ratau	Senior Advisor (Quality)
Goldstone Mungwe	Engineer (Generation Engineering) GX
Nad Moodley	Chief Engineer (Peaking Generation) GX
Mpumelelo Khumalo	Chief Engineer (Generation Engineering) GX
Annalie Lombard	Corporate Specialist (RT&D)
Vuyile Kula	HV Plant Senior Manager (Southern Grid, WG Leader)
Adesh Singh	Chief Engineer (Transformer and Reactors HV PDE)
Bheki Ntshangase	Senior Manager – HV Plant (SCOT PE SC Chairperson)

## **6. Revisions**

<b>Date</b>	<b>Rev</b>	<b>Compiler</b>	<b>Remarks</b>
Nov 2017	2	M. Ngubane	<ul style="list-style-type: none"><li>Upgraded corrosion resistance application on paragraph 3.3 to include C5-M requirement</li><li>Micro switch ratings revised from 1A to 0.25A on paragraph 3.9</li></ul>
April 2009	1	A Smit	<ul style="list-style-type: none"><li>Document revised to cater for Gx, Tx and Dx requirements</li></ul>

## **7. Development team**

The following people were involved in the recent revision of this document:

- Andries Smit
- Oupa Fokazi
- Sidwell Mtetwa
- Calvin Bongwe
- Michael Ngubane
- Vuyile Kula
- Adesh Singh
- Mohamed Mukuddem.

## **8. Acknowledgements**

The Work Group (Development Team) acknowledges all the people who reviewed this document and contributed with comments and advises. Further Acknowledgements go to all Eskom employees who made sure that the learning from the various activities forms part of this work, the people who compiled the divisional documents, and all transformer experts who shared their knowledge and experience.