Eskom	Standard	Technology

Title: **PASSIVE DEHYDRATING BREATHERS FITTED TO TRANSFORMERS, REACTORS AND ON-LOAD TAPCHANGERS SPECIFICATION**

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Content

1. Introduction

This document is required to clearly set out Eskom's requirements for the selection and purchase of dehydrating breathers fitted to Transformers and Reactors.

2. Supporting clauses

2.1 Scope

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

This document shall be used as a minimum requirement for the purchase and selection of passive dehydrating breathers relays fitted to transformers, reactors and on-load tapchangers.

- Passive dehydrating breathers fitted to new Transformers and Reactors
- Passive dehydrating breathers fitted to in-service Transformers and Reactors
- Passive dehydrating breathers purchased as Spare Parts

2.1.1 Purpose

The purpose of this document is be used for crosss-divisional of Tx, Gx and Dx

2.1.2 Applicability

This applies in all new transformers, reactors and on load tap-changers fitted dehydrating breathers.

Purchase of new breathers

Breathers fitted to new transformers

All breathers kept in transmission stores

Replacement breathers for transformers and reactors repaired in workshop and on site

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] RES\RR\10\32694 Transformer breather agent evaluation

[3] TRMTI114 Silica gel suitable for use in dehydrating breather applications

2.2.2 Informative

None

2.3 Definitions

2.3.1 General

Definition	Description
Large diameter breather	Breather with a containment tube diameter of 200 – 250 mm
Silica gel	Moisture removal desiccant used in dehydrating breathers
Small diameter breather	Breather with a containment tube diameter of 100 – 150 mm

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
g	Grams
ID	Internal diameter
kg	Kilograms
kV	Kilo volts
L	Litres
MVA	Mega Volt Ampere
OD	Outside diameter
PCD	Pitch circle 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

Every transformer, reactor and on-load tap changer shall be fitted with a dehydrating breather. Two types of breathers may be used, i.e. large diameter (200 – 250 mm diameter) and small diameter (100 – 150 mm diameter).

Large breathers shall be flange mounted on a 100 mm diameter flange with 4 x 12 mm holes on a 75 mm PCD. Small breathers shall have ¾" BSP female pipe thread mount.

The breather shall not be mounted higher that 1.5 m measured from the mounting flange or pipe connection point to ground level.

3.2 Environmental Conditions

Outdoor installation

Altitude above sea level – 1800 m

Ambient temperatures

- Maximum + 40°C
- Monthly average + 28°C
- Yearly average + 25°C
- Minimum – 10°C

Average relative humidity 90%

Solar radiation 2500 W/m²

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. The top and bottom castings shall be designed to prevent the collection of water.

Where cast components are used they shall be of high quality non-porous material. Bare metal or aluminium castings shall be epoxy powder coated (exterior grade) or anodised.

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

All fasteners shall be stainless steel – 316 grade bolts with 304 grade nuts shall be used. No electro galvanised or electro plated parts will be accepted.

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

3.4 Calculating of Silica Gel Quantity

The silica gel quantity shall be calculated according to the equipment oil volume. A minimum of 200 g of silica gel shall be used for every 1000 litres of total oil volume contained in the transformer or reactor.

Silica gel quantity shall not exceed 2 kg in a small diameter breather, and limited to 8 kg in large diameter breather single compartments.

3.4.1 Oil volume of up to 1000 litres

A small diameter breather shall not contain less than 1 kg of silica gel, even for equipment with an oil volume of less than 1000 litres. Typically 1 kg gel breathers shall be used on auxiliary transformers and on-load tapchangers where the oil volume does not exceed 1000 litres.

3.4.2 Oil volume of 1001 - 10 000 litres

Equipment with an oil volume in this range shall make use of small diameter breathers with a silica gel weight of 2 kg.

3.4.3 Oil volume of 10 001 – 30 000 litres

For units where the oil volume exceeds 10 000 litres but not 30 000 litres, a combination of large and small diameter breathers shall be used. The breather shall be sub-divided into 2/3 and 1/3 individual compartments. Where 2/3 of the silica gel shall be contained in a single compartment closest to the conservator (large diameter) and 1/3 shall be at the air intake side (small diameter). During maintenance only the silica gel in the compartment closest to the air intake shall be replaced.

3.4.4 Oil volume of 30 001 – 60 000 litres

Units in this range shall make use of large diameter breather combinations arranged in series, one below the other. The silica gel shall be sub-divided into 2/3 and 1/3 individual compartments of large diameter. Where 2/3 of the silica gel shall be contained in the compartment closest to the conservator and 1/3 shall be at the air intake side.

The breather size in this category shall not exceed 8 kg and 4 kg combinations thereby limiting this arrangement to a 60 000 litre equipment oil volume.

3.4.5 Oil volume of above 60 000 litres

Breathers where the oil volume exceeds 60 000 litres shall make use of three single breather compartments of large diameter. The three sections shall be mounted next to one another and have equal silica gel quantities. The breather compartments shall have a series air flow arrangement, but the physical connection to the transformer breather pipe shall be from the centre of the assembly.

The largest breather in this range shall be 3 x 8 kg silica gel charge configuration, even if the oil volume exceeds 120 000 litres.

3.5 Silica Gel Containment

Silica gel shall be contained in single completely transparent cylindrical tubes. The transparent tubes shall not be provided with a protective covering. Each container shall be manufactured from UV, oil and heat resistant material which can be simply and easily removed and replaced without the use of special tools. Glass shall not be used for manufacture of cylindrical tubes. Joints and inspection windows are not allowed in transparent cylindrical tubes.

The silica gel in large diameter breathers shall be arranged that the air passing through it shall be diffused throughout the charge so as to contact all particles in the charge, and in particular those observable from the outside. To achieve maximum air diffusion, baffle plates spaced at 2 kg silica gel weight separations shall be used inside the transparent containment tube. The baffle plates shall be mechanically strong enough to support the weight of the silica gel contained in the compartment.

Diffuser plates are not required in small diameter breathers.

The breather air intake hole connected to the equipment shall be provided with a dust filter. The dust filter shall prevent silica gel dust from entering the transformer pipework but shall not restrict airflow.

3.6 Oil Bowl

The silica gel shall not be in contact with the atmosphere unless the transformer is breathing, but shall be sealed by a bowl containing transformer oil. The designed oil level shall be minimum 100 ml and shall be clearly and permanently marked on the bowl.

The oil bowl shall be manufactured from transparent, UV stabilised, oil and heat resistant material – glass shall not be used. Design of the oil bowl shall allow for easy cleaning and removal. Fastening method of the oil bowl shall be designed that over-tightening will not cause damage to it. The oil bowl shall not be covered by a protective casing.

The oil inside the oil bowl shall not be drawn into the breather, contaminating the gel, or blown out of the oil containment bowl during normal operation of the transformer or reactor.

3.7 Air Intake during Starting of Oil Circulating Pumps

The arrangement and proportions of the dehydrating breather shall be such that air inhaled during starting of the oil circulating pumps shall receive adequate dehydration. Oil in the atmospheric seal shall not be drawn into the breather unit(s) during this operation, nor blown out of the oil seal during the operation of stopping the oil circulating pumps.

3.8 Gaskets: Types & Material

All seals on the breather shall be oil proof and airtight gaskets that shall be effectively retained on dismantling of the breather for the purpose of changing the silica gel.

All gasketed joints shall be designed, manufactured and assembled to ensure long term leak and maintenance free operation. Rubber seals used on silica gel charges shall be a minimum of 4 mm thick and manufactured from mirror finish Nitrile rubber with 60 shore hardness.

Cork gasket of 6 mm thick shall be used on flanged joints. As an alternative, “O”-rings may be used on flanged joints – in these instances “O” ring grooves shall be provided. The O-rings shall be of Nitrile rubber.

3.9 Leak and Flow Testing

Every breather shall be flow tested to ensure that the air flow path is free from obstructions and pressure tested to ensure there are no leaks in the assembly. This information shall be supplied with the breather.

3.10 Packing and Shipment

All breathers units shall be fully assembled and individually packed. The top opening of the breather shall be sealed by means of a blanking plate or stopper plug for breathers filled with silica gel – tape or plastic sheeting is not acceptable. The complete breather shall be sealed in a plastic bag (min 100 microns).

Breathers shall be supplied without silica gel unless otherwise requested by the Purchaser. When breathers are supplied with silica gel it shall be properly sealed to prevent moisture ingress into the gel during transport or storage. Only Envirogel™ or Trockenperlen™ in crystal form shall be used in Eskom breathers – comply with TRMTI114.

3.11 Maintenance Documentation

Each breather shall be supplied with installation and maintenance instructions.

4. Technical Evaluation and Final Approval

The OEM / Supplier shall be responsible to supply a breather 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 supply dehydrating breathers. 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:

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6. Revisions

Date	Rev	Compiler	Remarks
Nov 2017	2	M Ngubane	• Upgraded corrosion coating requirements on paragraph 3.3 to include C5-M requirements
April 2009	1	A Smit	• Document revised to cater for Gx, Tx and Dx requirements

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
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- Mohamed Mukuddem

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