Eskom	Standard	Technology

Title: **OIL AND GAS ACTUATED (BUCHHOLZ) RELAYS FITTED TO TRANSFORMERS AND REACTORS SPECIFICATION**

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Content

1. Introduction

Buchholz relays are used on power transformers and reactor to detect excessive gas accumulation, sudden flow of oil from the main tank to the conservator and loss of oil. The reliability of this relay is of great importance to ensure the reliability of the protected equipment. The requirements of this specification are important to ensure that this reliability is achieved and thus the relay is manufactured to suit the prevailing site conditions.

2. Supporting clauses

2.1 Scope

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

This document shall be used as a minimum requirement for the purchase and selection of gas and oil actuated (Buchholz) relays fitted to transformers and reactors.

- Buchholz relays fitted to new Transformers and Reactors
- Buchholz relays fitted to in-service Transformers and Reactors
- Buchholz relays 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] 240-56062720 Standards for labelling of oil sample points on transformers and reactors.

2.2.2 Informative

None

2.3 Definitions

2.3.1 General

Definition	Description
Buchholz relay	Gas and oil actuated relays

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
mm/s	Millimetre per second
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

An oil and gas actuated relay suitable for operation in transformer oil as specified over the temperature range from - 10°C to + 115°C shall be interposed in the connecting pipe between the oil conservator and the transformer tank. The relay shall be fitted in such a manner that all the gasses from the tank pass through and are trapped by the relay as the gasses move towards the oil conservator.

For the purpose of redundant protection, transformers and reactors having a voltage rating of 220 kV and above or a rating of 100 MVA(r) and above shall be provided with two Buchholz relays. The relays shall be installed in series in the connecting pipe between the oil conservator and the transformer tank, mounted at least five pipe diameters apart - measured from facing flanges.

NB: The internal surfaces of the relay shall be finished in glossy white, oil resistant enamel paint.

The relay shall withstand the internal pressure of 100 kPa and full vacuum at sea level without damage. Expected design life of the Buchholz relay shall match the design life of a transformer, at least 40 years.

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. 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.

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

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.

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 Alarm and Tripping Contacts

Two normally open contacts shall be provided, one for alarm signalling and one for trip signalling. Only reed type switches approved by Eskom shall be used. Mercury switches are not acceptable. Contacts shall be pre-set and rated for 1 A at 220 V DC.

The device's electrical circuits shall withstand an applied voltage of 2 kV DC for 60 seconds, applied in turn, between electrically independent circuits and the casing of the device, and between the separate independent electrical circuits. The open contact shall withstand an applied voltage of 2 kV DC for 60 seconds.

Modifications to OEM supplied relays to alter alarm and trip signalling levels shall not be permitted.

3.5 Alarm Signalling

The alarm contact shall close by falling of the oil level inside the relay to a predetermined point due to:

- Deficiency of oil - low oil level
- Presence of gas in the relay - gassing inside the main tank (fault condition) or escape of free gas to the conservator tank (trapped air)

When free gasses generated inside the transformer or reactor rise to the conservator tank and enter the Buchholz relay the alarm float shall drop to give alarm signalling at gas volumes specified in Table 1:

Table 1: Alarm signalling gas volumes

Transformer total oil content	Relay nominal size	Alarm gas volumes
≤1 000 litres	25 mm	150 ± 50 cm^3
1001 - 10 000 litres	50 mm	300 ± 50 cm^3
> 10 000 litres	80 mm	400 ± 100 cm^3

3.6 Trip Signalling

The trip contact shall close due to:

- Deficiency of oil - low oil level
- Presence of gas in the relay to a point before the gas escapes to the conservator - gassing inside the main tank (fault condition) or escape of free gas to the conservator tank (trapped air) – Table 2.
- When there is a surge of oil through the relay towards the conservator with a rate of flow as specified in Table 2.

Table 2: Trip signalling requirements

Transformer total oil content	Relay nominal size	Trip gas volumes	Trip steady oil flow rate
≤1 000 litres	25 mm	300 ± 50 cm^3	1000 ± 150 mm/s
1001 - 10 000 litres	50 mm	700 ± 100 cm^3	1000 ± 150 mm/s
10 001 - 50 000 litres	80 mm	800 ± 100 cm^3	1000 ± 150 mm/s
> 50 000 litres	80 mm	800 ± 100 cm^3	2000 ± 200 mm/s

3.7 Relay Stability

No maloperation of the relay shall result from starting, running or stopping of the transformer oil circulating pumps under any oil temperature conditions. Stability, in this regard, shall not be achieved by the use of pipe or relay aperture baffles to the impairment of sensitivity to oil surges as specified.

The equipment shall withstand the effects of vibration, earth tremors and blasting and shall comply with IEC 255-21-3.

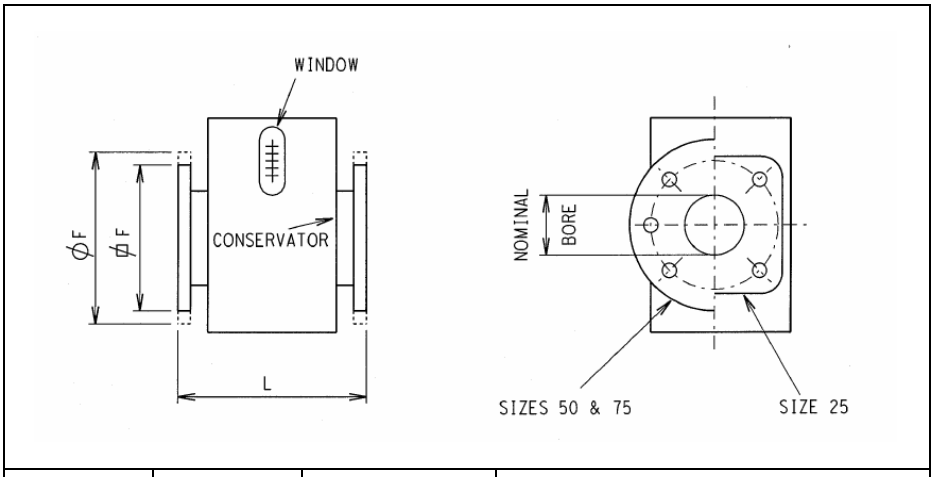
The relay shall not operate for through fault conditions or be influenced by the magnetic fields around the transformer under normal or external fault conditions.

3.8 Mounting and Marking of Relays

Pipe mounting flanges and relay lengths between flange facings shall, unless otherwise approved, comply with Figure 1.

Each relay shall be supplied with a permanent engraved nameplate with the following information: Make, Type and Serial Number. The nameplate shall be manufactured from non-corrodible material and permanently fixed to the Buchholz relay.

Each relay shall bear clear indication (permanent marking – paint or stick-on labels is not acceptable) as to which is the conservator end. Embossed markings that cannot be removed by painting or solvents shall be used – an arrow, indicating the direction to the conservator tank, is sufficient.



Nominal Bore	Length (L)	Flange Size (F)	Bolt Holes		
			No	Size	PCD
25 mm	127 mm	75 mm (Square)	4	Tapped M10	72 mm
50 mm	185 mm	Ø 140 mm	6	12 mm	110 mm
80 mm	185 mm	Ø 160 mm	6	12 mm	130 mm

Figure 1: Buchholz relay outline drawing and sizes

3.9 Windows

Windows (one per side) shall be provided on opposing sides of the relay and so arranged that the oil level in the relay may be clearly gauged. Tempered glass shall be used as the only acceptable gauge glass material.

Windows shall be of adequate size to allow the oil level to be visible from ground level under alarm and trip conditions. Relays shall not be fitted with flaps that cover the windows.

3.10 Gas Release and Oil Sample Point

All Buchholz relays shall be fitted with a single gas release / oil sampling point. This point shall be provided with a SAE 45-degree flared pipe connection installed directly into the top casting of the relay. The hole shall be sealed for transportation and storage and no valve shall be fitted.

During installation a sample pipe of copper tubing with an ID of 8 mm and an OD of 10 mm shall be installed. All fittings used shall be brass or stainless steel. Only SAE 45-degree flares shall be used on the copper tubing - compression fittings are not acceptable. The tubing shall be protected against physical damage by appropriate routing, fastening and / or protective conduit. The tubing shall not be raised above the minimum oil level in the conservator tank.

A sample valve shall be provided and secured approximately 1,5 m above ground level and be easily accessible from the transformer plinth. No gas sample / trap device shall be provided.

The sample valve shall be a needle type valve of 10 mm size – ball valves shall not be used. Only brass or stainless steel needle valves shall be used. A stopper plug shall be provided to seal the open end of the sample valve.

This oil sample point shall be labelled according to Standard 240-56062720.

3.11 Relay Alarm and Trip Signalling Testing

Each Buchholz relay shall have an approved mechanical device that operates the float mechanism (not only the switch contacts) for simulating of the gas alarm, gas trip and surge trip signals. The push button shall activate the alarm contact first and then the trip contact.

Gas injection on the relay itself, to operate the alarm and tripping signals, is not allowed.

3.12 Electrical Connections and Terminal Box

A terminal box with IP 55 rating shall be provided for electrical connections on the relay. Nitrile rubber gasket shall be used on the terminal box cover. Terminal box cover screws shall be hexagon or Allen key type stainless steel with thread lubrication applied.

The alarm signalling and the tripping contacts shall be electrically separate and independent, and shall be externally connected inside the terminal box. Plug-in connectors shall not be used.

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 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 relay 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.

3.13 Floats

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.

3.14 Documentation and Packaging

A standard test card bearing the manufacturer's serial number of the relay shall be included with each of the operating instruction manuals required for the relays. Each relay shall be supplied with a calibration certificate and all relevant test information as required by this document. Calibration of Buchholz relays shall be carried out SANAS approved laboratories.

Original and fully detailed instructions for assembly, operation and maintenance of the relay shall be included with each relay. The relay shall be securely packed and properly protected against damage and moisture ingress during shipping and storage.

The flange openings and oil sample pipe connection point shall be suitably sealed to prevent ingress of dirt and moisture during shipment and long term storage.

3.15 Technical Evaluation and Final Approval

The OEM / Supplier shall be responsible to supply a Buchholz relay 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 Buchholz relays. Any deviation from this specification has to be approved by Eskom in writing before ordering or manufacturing of the relay.

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.

4. Authorization

This document has been seen and accepted by:

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5. Revisions

Date	Rev	Compiler	Remarks
Nov 2017	2	M.Ngubane	• Document revised to include upgraded corrosion protection on paragraph 3.3 to include C5-M requirements. • The open contact shall withstand an applied voltage of 2 kV DC for 60 seconds on paragraph 3.4
May 2009	1	A Smit	• Document revised to cater for Gx, Tx and Dx requirements

6. Development team

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

- Andries Smit
- Oupa Fokazi
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- Calvin Bongwe
- Michael Ngubane
- Vuyile Kula
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- Mohamed Mukuddem

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