**SULTANATE OF OMAN**


**AUTHORITY FOR ELECTRICITY REGULATION**

# STANDARD OES-37

# DISTRIBUTION TRANSFORMERS NOT CONTAINING LIQUID INSULANT (Dry type transformers)

**Second Edition : August 2019**

# Contents

# 1 Introduction

This Oman Electrical Standard sets out requirements for distribution transformers not containing insulating oil or other liquid insulant and for use in indoor distribution substations (reference OES36). This Oman Electrical Standard should be read in conjunction with OES 11.

# 2 Type

Transformers in compliance with this Oman Electrical Standard shall be of an air natural (AN) or air natural/air forced (AN/AF) indoor design and comply with the requirements of IEC 60076-11, for operation on 50Hz systems.

# 3 Rating

The rating specified shall be the sustainable continuous rating under the most onerous operating conditions for Oman as stated in OES 11.These conditions are regarded as unusual service conditions in IEC 60076-11.

# 4 Voltage Ratio

The nominal voltage ratio of transformers to this standard shall be 11000/433V

Tappings shall be provided on the high voltage winding to provide ratios of +2.5%, +5%

-2.5% and -5% of nominal voltage.

Tap changing shall be by means of an externally accessible off load switch lockable in each of the five tap positions. It shall not be possible to lock the switch in an inter-tap position.

# 5 Impedance Voltage

The impedance voltage of the transformer shall be 4.75% for units of ratings up to and including 1000 kVA, 6% for 1600kVA and 8% for 2000kVA. Above 2000kVA shall be subject to site-specific short circuit level study.

| Rating (kVA) | Impedance Voltage (%) |
|---|---|
| Up to and including 1000 | 4.75 |
| 1600 | 6 |
| 2000 | 8 |

# 6 Temperature Rise

Transformers shall be capable of carrying full load current continuously under all conditions stated in OES 11 without the temperature of the winding rising more than 100 $^{o}$C above an ambient of 50 $^{o}$C.

## 7 Connections

Transformers shall be three phase with delta connected primary windings and star connected secondary windings with IEC 60076-11-Part1,vector reference Dyn11 arrangement. The low voltage neutral point shall have a connection brought out into the low voltage cable termination box.

## 8 Performance Under Fault Conditions

Transformers shall be capable of sustaining a three phase symmetrical short circuit on the low voltage side with power maintained on the high voltage side without damage or distress for three seconds.

Transformers shall be designed and constructed to withstand without damage the thermal and dynamic effects of external short circuits under the conditions specified in OES 11

- Thermal ability to withstand short circuits is to be demonstrated by calculations in accordance with IEC 60076-11 requirements
- The dynamic ability to withstand short circuits is to be demonstrated by test or reference to type tests on transformers of similar design and rating conducted at independent test facilities.

## 9 Core

The core shall be constructed from low loss cold rolled grain oriented electrical steel laminations insulated to minimise losses and secured by suitably insulated bolts and clamps in accordance with IEC 60076-11 for dry type transformers.

## 10 Windings

All windings shall be of copper, insulated in accordance with IEC 60076-11 for dry type transformers for a highest system voltage of 12.5kV.

Insulation shall be to IEC 60085 Class 155 (National Electrical Manufacturers Association (NEMA) Class F standard).

## 11 Enclosure

Transformers shall be contained in a metal enclosure, which shall be sufficiently robust and adequately protected to withstand the climatic and atmospheric conditions of Oman, offering ingress protection to a minimum of IP31 level in accordance with IEC60529.

## 12 Connection Arrangements

Transformers shall be fitted with cable boxes to BS 2562 designed for dry type cable terminations as follows:

| | Minimum Clearances | Cable connection capability per phase (XLPE Copper) | |
|---|---|---|---|
| High Voltage | 180 mm phase to phase<br>100 mm phase to earth | 2000 kVA and below<br>2001 kVA to 3000kVA | 1* 50mm$^2$<br>1* 70mm$^2$ |
| Low voltage | 120mm phase to phase clearance<br>25 mm phase to earth clearance | 500 kVA<br>1000kVA<br>Above 1000kVA | 1*630 mm$^2$<br>2*630mm$^2$<br>Individual design or bus ducting |

## 13 Earth terminals

Two frame earth terminals shall be provided on each transformer.

## 14 Fittings

Transformers shall be fitted with:

- An overall cover of minimum ingress protection IP31 level
- Lifting eyes or lugs
- Roller wheels
- Name plate to IEC 60076-11 engraved or stamped with the following details
    - Rating in kVA
    - Rated Primary & Secondary Voltages
    - Frequency
    - Number of phases
    - Vector reference group symbol
    - No load HV Voltage and LV Voltage at normal tap
    - Full load HV Current and LV Current at normal tap
    - No load losses
    - Full load losses
    - Connection diagram
    - Impedance Voltage
    - Type of Cooling
    - HV/LV temperature rise
    - Weight
    - Manufacturer
    - Manufacturers Type
    - Manufacturer's Serial Number
    - Year of Manufacture

## 15 Tests

Type tests, routine tests and tests for unusual service conditions shall be carried out in accordance with IEC 60076

## 16 Losses

The No Load and Full load losses for transformers to this standard shall not exceed:

| Rating (kVA) | No load losses (kW) | Full load losses (kW) |
|---|---|---|
| 500 | 1.2 | 4.5 |
| 630 | 1.4 | 6.5 |
| 1000 | 2.0 | 8 |
| 1600 | 2.8 | 12.5 |
| 2000 | 3.4 | 15 |

## 17 Noise

The noise emission for transformers to this standard shall not exceed:

| Rating (kVA) | Form of Enclosure Ventilation | |
|---|---|---|
| | Air Natural (AN) Cooled (dB) | Air Forced (AF) Cooled (dB) |
| 500 | 60 | N/A |
| 630 | 62 | 67 |
| 1000 | 64 | 68 |
| 1600 | 65 | 70 |
| 2000 | 66 | 71 |

## 18 Painting and Finishes

Metal enclosures for transformers to this standard shall be finished to provide a minimum corrosion protection level of Class C3. In case of a very humid / corrosive areas a minimum corrosion protection level of Class C5-I or C5–M shall be considered. Painting and finishes shall have a minimum maintenance period of 15 years in accordance with ISO Standard 12944.