International Association of Oil & Gas Producers

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Supplementary Specification to IEC 60076-1 Transformers

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
1.0	December 2020	Issued for Use

Acknowledgements

This IOGP Specification was prepared by a Joint Industry Programme 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

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Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2014).

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Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of transformers in accordance with IEC 60076-1, Edition 3, 2011-04, Power Transformers for application in the petroleum and natural gas industries.

This specification follows a common document structure comprising the four documents as shown below, which together with the purchase order define the overall technical specification for procurement.

JIP33 Specification for Procurement Documents
Supplementary Technical Specification

This specification is to be applied in conjunction with the supporting data sheet, quality requirements specification (QRS) and information requirements specification (IRS) as follows.

IOGP S-720: Supplementary Specification to IEC 60076-1 Transformers

This specification defines the technical requirements for the supply of the equipment and is written as an overlay to IEC 60076-1, following the IEC 60076-1 clause structure. Clauses from IEC 60076-1 not amended by this specification apply as written to the extent applicable to the scope of supply.

Modifications to IEC 60076-1 defined in this specification are identified as *Add* (add to clause or add new clause), *Replace* (part of or entire clause) or *Delete*.

IOGP S-720D: Data Sheet for Transformers

The data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the technical specification. The data sheet may also include fields for supplier provided information attributes subject to purchaser's technical evaluation. Additional purchaser supplied documents may also be incorporated or referenced in the data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-720Q: Quality Requirements for Transformers

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the data sheet or in the purchase order.

IOGP S-720L: Information Requirements for Transformers

The IRS defines the information requirements, including contents, format, timing and purpose to be provided by the supplier. It may also define specific conditions which invoke information requirements.

The terminology used within this specification and the supporting data sheet, QRS and IRS follows that of IEC 60076-1 and is in accordance with ISO/IEC Directives, Part 2 as appropriate.

The data sheet and IRS are published as editable documents for the purchaser to specify application specific requirements. The supplementary specification and QRS are fixed documents.

The order of precedence (highest authority listed first) of the documents shall be:

a) regulatory requirements;

b) contract documentation (e.g. purchase order);

c) purchaser defined requirements (data sheet, QRS, IRS);

d) this specification;

e) IEC 60076-1.

1 Scope

Replace clause with

Add new subclause

1.1 General

This specification amends and supplements IEC 60076-1 and associated parts of IEC 60076 referenced in IEC 60076-1 for the design, manufacture and testing of three-phase and single-phase power transformers, including auto-transformers.

Add new subclause

1.2 Transformers included in scope

Included in the scope of this specification are the following types of transformers:

– liquid filled transformers equipped with a breather and a conservator;

– sealed type liquid filled transformers;

– dry type transformers;

– liquid filled and air core reactors;

– converter transformers;

– transformers having no windings exceeding 1 000 V for industrial applications.

For categories of power transformers and reactors which have their own IEC standards, this specification is applicable only when it is specifically called up by cross reference in the other standards. Such standards exist for:

– reactors in general (IEC 60076-6);

– dry-type transformers (IEC 60076-11);

– converter transformers for industrial applications (IEC 61378-1).

Add new subclause

1.3 Transformers excluded from scope

Excluded from the scope of this specification are the following types of transformers:

– single-phase transformers with rated power less than 1 kVA and three-phase transformers less than 5 kVA;

– instrument transformers;

– traction transformers mounted on rolling stock;

– starting transformers;

– testing transformers;

– welding transformers;

– mining transformers;

– transformers for deep water (submerged) applications.

Where IEC standards do not exist for such categories of transformers, this specification may still be applicable either as a whole or in part.

2 Normative references

Add to clause

IEC 60034-1, *Rotating electrical machines – Part 1: rating and performance*

IEC 60076-6, *Power transformers – Part 6: Reactors*

IEC 60076-14, *Power transformers – Part 14: Liquid-immersed power transformers using high-temperature insulation materials*

IEC TS 60076-20, *Power transformers – Part 20: Energy efficiency*

IEC 60079 (all parts), *Explosive atmospheres*

IEC 60085, *Electrical insulation – Thermal evaluation and designation*

IEC 60099-4, *Surge arresters – Part 4: Metal oxide surge arresters without gaps for a.c. systems*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC TR 60616, *Terminal and tapping markings for power transformers*

IEC TS 60815-1, *Selection and dimensioning of high voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles*

IEC 60836, *Specifications for unused silicone insulating liquids for electrotechnical purposes*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2:Generic standards – Immunity standard for industrial environments*

IEC 61000-6-4, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Emission standard for industrial environments*

IEC 61099, *Insulating liquids – Specifications for unused synthetic organic esters for electrical purposes*

IEC 61378-1, *Converter transformers – Part 1: Transformers for industrial applications*

IEC 61869-2, *Instrument transformers – Part 1: Current transformers*

IEC 61892-3, *Mobile and fixed offshore units – Electrical installations – Part 3: Equipment*

IEC 62535, *Insulating liquids – Test method for detection of potentially corrosive sulphur in used and unused insulating oil*

3 Terms and definitions

Add new term

3.13.4
phase segregated terminal box
a terminal box so designed that phase segregation is provided by earthed metallic barriers forming completely distinct individual phase compartments so as to restrict any electrical breakdown to an earth fault

[SOURCE: IEC 60050-411, 41-35, modified - note deleted]

4 Service conditions

4.2 Normal service conditions

f) Installation environment

Replace fourth paragraph with

Environmental conditions within the following definitions according to IEC 60721-3-4:

– climatic conditions (K);

– special climatic conditions (Z);

– biological conditions (B);

– chemically active substances (C);

– mechanically active substances (S);

– mechanical conditions (M).

Add to subclause

The transformer shall be designed for 90 % maximum relative humidity.

Add to subclause

The design of transformers for outdoor operation shall incorporate operation without a protective shelter.

Add to subclause

Humidity changes caused by short term cyclic ambient temperature variations shall not compromise the performance of the transformer.

Add to subclause

The installation environment shall apply to the transformer and ancillaries, for example motors, components and accessories.

Add new subclause g)

g) Hazardous area

Transformers and reactors in hazardous areas shall comply with the applicable requirements of IEC 60079.

Add new subclause h)

h) Dry type transformers and reactors

Climatic, environmental and fire behaviour classes shall be in accordance with IEC 60076-11, Clause 12.

Add new subclause i)

i) Offshore locations

Transformers installed in offshore locations shall be provided in accordance with IEC 61892-3.

5 Rating and general requirements

5.1 Rated power

5.1.1 General

Add to subclause

A transformer feeding a group of motors shall maintain operational performance following:

– infrequent restarting loads of up to 1,8 times the rated current of the transformer;

– five restarts in succession at five second intervals.

Add to subclause

Motor unit transformers supplying individual motors shall maintain operational performance following:

– three successive motor starts and a further two successive starts after a cooling-off period of 30 minutes;

– 3 000 starts per year or greater.

Add to subclause

Transformers within the scope of IEC TS 60076-20 shall comply with the energy efficiency requirements in accordance with IEC TS 60076-20 level 2.

Add to subclause

Transformers shall have a design lifetime of at least 25 years operating at rated output under the specified service conditions.

Add to subclause

The design of transformers shall be for continuous operation at full load for at least 45 000 hours without maintenance which requires the transformer to be de-energized.

NOTE Reduction in continuous operation time due to the OLTC maintenance interval based on operational count is allowed.

5.2 Cooling mode

Add to subclause

When specified, the provision for future installation of cooling fans without hot work, for example grinding and welding, shall be provided.

5.7 Additional information required for enquiry

5.7.3 Sound level

Add to second paragraph

The maximum sound pressure level of the transformer at rated load with forced cooling fans in operation shall be provided.

Add to subclause

Compliance with sound power limit shall be achieved without the use of a sound attenuation enclosure.

5.7.4 Transport

Add new subclause

5.7.4.3 Mechanical handling

5.7.4.3.1

Jacking pads shall be provided for transformers with an assembled mass of 2 000 kg or greater.

5.7.4.3.2

Lifting and jacking points shall be mounted on tanks, enclosures and frames.

5.7.4.3.3

Location of the lifting and jacking points shall not lead to damage of the transformer enclosure and frame.

5.7.4.3.4

The location of lifting and jacking points shall be identified on the general arrangement drawing and marked on the tank, enclosure or frame.

5.7.4.3.5

Transformers and associated cooling equipment, when transported separately, shall have lifting lugs to facilitate transportation and assembly at site.

5.7.4.3.6

Assemblies or equipment parts weighing more than 25 kg shall have provisions for lifting.

5.7.4.3.7

Shipping restraints, for example transport blocks, bindings shall be marked for the purpose of removal.

5.7.4.3.8

Loose parts and components with moving parts at risk of damage during shipment shall be securely blocked and braced.

NOTE Blocking is intended to prevent lateral movement and bracing is intended to prevent vertical movement.

5.7.4.3.9

Transformers and radiators, if transported without insulating liquid, shall be inerted in nitrogen or with clean dry air.

5.7.4.3.10

When transported inerted, transformers and associated cooling equipment shall be equipped with devices to enable the internal pressure to be measured.

5.7.4.3.11

Openings shall be protected by metal covers to prevent damage during transportation.

5.8 Components and materials

Add to subclause

Insulating liquids shall comply with IEC 61099 for synthetic organic esters, with IEC 60836 for silicon oil.

Add to subclause

Insulating liquids shall not contain or be contaminated with polychlorinated biphenyls.

Add to subclause

All materials, including gaskets and sealants, shall be free from asbestos, mercury, ceramic fibre and chlorofluorocarbons.

8 Rating plates

8.2 Information to be given in all cases

Add before list item a)

The following information shall be included on the rating plate:

Add new list item q)

q) Supplier's purchase order number.

Add new list item r)

r) Transformer's tag number.

8.3 Additional information to be given when applicable

Add new list item l)

l) Tank design pressure for sealed type transformers with a gas cushion.

Add new list item m)

m) A plate with an overview of the cooling circuit, including valves, check valves, pumps and sensors, and the indication for direction of flow in case of liquid filled transformers with circulating pumps for the cooling circuit.

9 Safety, environmental and other requirements

9.2 Dimensioning of neutral connection

Add to subclause

The low voltage neutral terminal of polyphase liquid immersed distribution transformers shall be rated for 50 % or greater of the phase current.

9.3 Liquid preservation system

Add to subclause

Desiccant used in the breather shall be non-carcinogenic and regenerative type.

Add to subclause

Sealed-tank transformers with a permanent nitrogen cushion shall not require nitrogen pressure adjustment at site.

9.5 Centre of gravity marking

Add to subclause

The centre of gravity shall be indicated on the general arrangement drawings.

Add new subclause

9.6 Construction requirements

9.6.1 General

9.6.1.1

Where specified, liquid immersed transformers and reactors shall be provided with relief valve type pressure relief devices with mechanical operation indicator.

9.6.1.2

Pressure relief devices shall be provided with a trip contact.

9.6.1.3

Where specified, pressure relief devices shall be provided with a facility for directing emissions of liquid from the relief device in the direction away from the transformer.

9.6.1.4

Indicating instruments shall be accessible for maintenance without obstruction.

9.6.1.5

Indicating instruments shall be readable from ground level.

9.6.1.6

For the following applications, enclosures shall offer the specified degree of protection in accordance with IEC 60529:

– Indoor- IP41, IP2X with the enclosure doors open;

– Outdoor - IP56.

9.6.1.7

Access panels shall be provided for liquid immersed transformers and reactors for allowing maintenance of internal components, for example internals of cable boxes, OLTC contacts, main power bushings and current transformers.

9.6.1.8

Liquid immersed transformers and reactors shall be provided with a sampling orifice fitted with a valve for condition monitoring of the liquid for each fluid compartment.

NOTE It is allowed to combine sampling orifice with the draining orifice.

9.6.2 Tanks and radiators

9.6.2.1

Sample valves shall be fitted with a chained screwed plug.

9.6.2.2

For liquid immersed transformers and reactors, devices fixed to the tank or tank lid shall be flanged.

9.6.2.3

Removable radiators shall have:

– isolating valves on tank and radiator sides; and

– vent and drain orifices fitted with screw plugs.

9.6.3 Conservators

9.6.3.1

Conservators shall be removable for transportation.

9.6.3.2

Conservators shall be provided with the following:

– a level indicator;

– a filling hole with screwed plug;

– a combined filter and drain valve;

– a detachable end plate for cleaning access;

– a lockable isolating valve;

– a dehydrating breather;

– a standpipe to prevent sludge from entering the tank.

9.6.3.3

The liquid level indicator on the conservator shall be provided with minimum and maximum level markings.

9.6.3.4

Transformers and reactors with conservators shall be provided with a Buchholz relay.

9.6.3.5

The Buchholz relay shall be provided with:

– alarm and trip contacts;

– an air relief valve;

– flanges and valves to isolate the relay without draining the insulating liquid.

9.6.3.6

Breathers shall be accessible from ground level.

9.6.3.7

Breathers shall be protected from mechanical damage.

9.6.4 Valves

9.6.4.1 Valves

Valves shall be provided with permanently marked position indication for open and closed positions.

9.6.4.2

Devices, except thermowells, fixed to the tank of liquid immersed transformers and reactors shall have a lockable isolation valve.

9.6.5 Windings and tappings

Winding interconnections inside the transformer shall be brazed or crimped.

9.6.6 Earthing

9.6.6.1

Metal parts of the core, frame, tank, cable boxes and internal earthing bars or studs shall be interconnected for earthing on the tank earthing boss.

9.6.6.2

Liquid immersed transformers and reactors shall be provided with accessible core and frame earth connections with removable links to provide access for maintenance and commissioning when filled with liquid.

9.6.6.3

Two sets of earthing terminals or earthing pads for termination of the earth strip or earth cable of the size specified shall be provided on the tank of the transformer.

9.6.7 Cooling

9.6.7.1

When forced cooling is specified, the associated control cubicle shall be mounted on the transformer.

9.6.7.2

For liquid immersed transformers and reactors equipped with a liquid to water heat exchanger, the heat exchanger shall be double wall design.

9.6.7.3

For liquid immersed transformers and reactors equipped with a liquid to water heat exchanger, a leakage monitoring system with alarm contact shall be provided.

9.6.7.4

Materials exposed to cooling water in heat exchangers shall be protected against corrosion caused by exposure to the cooling water.

9.6.7.5

Dry type transformers equipped with a water to air heat exchanger, shall be provided with monitoring of leakage from the heat exchanger inside the enclosure of the transformer.

9.6.7.6

Dry type transformers equipped with a water to air heat exchanger, shall be provided with moisture sensors in the air flow circuit to detect leakage.

9.6.7.7

Condensation shall not accumulate in the heat exchanger air circuits.

9.6.7.8

Cooling air ducts and cooling fan protective covers shall be provided with IP2X protection.

9.6.8 Temperature measurement

9.6.8.1

A thermowell shall be provided at the top of the tank to measure the top liquid temperature.

9.6.8.2

The top liquid indicator shall be a dial-type and calibrated in degrees Celsius.

9.6.8.3

The liquid and winding temperature indicators shall be fitted with two adjustable setting contacts for remote alarm and trip purposes.

9.6.8.4

The liquid and winding temperature indicators shall be fitted with a hand-reset pointer to register the highest temperature attained.

9.6.8.5

Winding temperature measurement shall be thermally compensated type.

9.6.8.6

Thermistors shall be positive temperature coefficient (PTC) type.

9.6.8.7

Winding temperature measurement thermistors and resistance elements shall be supplied with the auxiliary equipment necessary to initiate remote alarms/trips via voltage-free changeover contacts.

9.6.8.8

A minimum of two winding temperature measurement thermistors or resistance elements shall be provided per phase.

9.6.9 Cable connecting boxes

9.6.9.1

Cable connecting boxes shall be made of steel.

9.6.9.2

The dimensions of the cable connecting boxes shall be designed for air-insulated connections including:

– clearances;

– creepage distances.

9.6.9.3

When specified, HV and LV cable connecting boxes shall be separate for:

– the HV side of the transformer;

– the LV side of the transformer;

– the auxiliary circuits of the transformer, for example direct measuring alarm/trip devices and current transformer (CT) secondaries;

– forced cooling installation, if installed;

– the on-load tap changer, if installed;

– the neutral connection for transformers with HV secondary voltages.

9.6.9.4

The cover of cable boxes shall be secured by means of captive bolts or screws.

9.6.9.5

Where specified, transformers installed outdoors shall incorporate metal canopies over cable connecting boxes.

9.6.9.6

The canopy shall have an overhang of at least 50 mm on each side.

9.6.9.7

The canopy shall be sloped to prevent accumulation of water.

9.6.9.8

An air space of at least 50 mm above the top cover shall be provided for ventilation.

9.6.9.9 Main cable connecting box

9.6.9.9.1

Main cable connecting boxes shall be designed to minimize bending requirements for single core or multicore cable conductors.

9.6.9.9.2

If two or more parallel conductors are connected, straight conductors, for example copper bars or flags, shall be provided to permit the cable conductors to be separately terminated.

9.6.9.9.3

Connections shall be sized to carry the maximum continuous current and the prospective through-fault currents.

9.6.9.9.4

Test certificates or calculations for main cable connecting boxes shall state their short circuit withstand capability.

9.6.9.9.5

Main cable connecting boxes shall have accessible removable links for dielectric testing of cables.

9.6.9.9.6

Copper earthing bars shall be provided for the earthing of the protective screen and/or armour inside the cable connecting box for cables.

9.6.9.9.7

When site conditions require a method of preventing condensation in main cable boxes, a method shall be proposed.

9.6.10 Cable terminations

9.6.10.1 Gland plates

9.6.10.1.1

Cable boxes shall be provided with undrilled gland plates.

9.6.10.1.2

Gland plates shall be separate from those used for the interconnecting cables of the on-skid auxiliary equipment.

9.6.10.1.3

For single core conductors, gland plates of main cable connecting boxes shall be constructed from a non-magnetic material.

9.6.10.2 Bushings

9.6.10.2.1

Bushings inside cable boxes shall comply with site pollution severity class c in accordance with IEC TS 60815-1.

9.6.10.2.2

For outdoor transformers and reactors, exposed bushings shall comply with site pollution severity class e in accordance with IEC TS 60815-1.

9.6.10.2.3

Bushings shall withstand mechanical loading arising from the cable termination.

9.6.10.3 Liquid filled cable box

9.6.10.3.1

The liquid filled cable box shall be equipped with a liquid sampling/drain valve and a vent plug.

9.6.10.3.2

Where specified, a pressure relief device with trip contacts shall be fitted to a liquid filled cable box.

9.6.11 Terminals

9.6.11.1 Main terminals

9.6.11.1.1

Main terminals shall be suitable for the cables specified.

9.6.11.1.2

Cable clamping arrangements shall be provided in accordance with the cables specified.

9.6.11.1.3

Clearly and indelibly marked terminals shall be provided to identify the phase connections in accordance with the connection diagram on the rating plate.

9.6.11.1.4

Main cable terminations shall be sized in accordance with the specified cable types and sizes.

9.6.11.2 Auxiliary terminals

9.6.11.2.1

Auxiliary terminal blocks shall be provided with individual terminals for each external cable core.

9.6.11.2.2

Auxiliary terminals shall be modular, finger-proof, non-loosening, wedge type.

9.6.11.2.3

Auxiliary terminal blocks shall be grouped by function (analog and digital signals) and operating voltage.

9.6.11.2.4

Barrier plates shall separate each group of auxiliary terminals.

9.6.11.2.5

Auxiliary terminals shall be clearly and indelibly marked in accordance with the auxiliary wiring diagrams and IEC TR 60616.

9.6.11.2.6

Measuring instrument and signal cabling shall be routed to a terminal box located on the outside of the enclosure.

9.6.12 Cable supports and clamps

9.6.12.1

Cable supports and clamps for the main cables shall be provided within 500 mm of the bottom of the cable box gland plate.

9.6.12.2

Spacing between supports/clamps for the main cables shall not exceed 500 mm.

9.6.13 Surge arresters

When specified, transformers shall be equipped with surge arresters complying with IEC 60099-4.

9.6.14 Auxiliary wiring

9.6.14.1

Conductors shall be stranded copper with a cross-section of at least 1,5 mm^2.

9.6.14.2

Auxiliary wiring and cabling shall be provided with ferrules.

9.6.14.3

Auxiliary cables shall be wire braided or wire armoured.

9.6.15 Motors

9.6.15.1 Electric motors

All motors shall have a minimum degree of protection of IP55, in accordance with IEC 60529.

9.6.15.2

The motor insulation system shall be thermal class 155 (F) in accordance with IEC 60085 without exceeding thermal class 130 (B) temperature limits at the motor rated output at maximum ambient air temperature.

9.6.16 Current transformers

9.6.16.1

When specified, current transformers shall be in accordance with IEC 61869-2.

9.6.16.2

Secondary terminals of current transformers shall be wired to a terminal block in the transformer auxiliary cable connecting box.

9.6.16.3

One side of the secondary winding of each current transformer circuit shall be earthed at the terminal block.

9.6.16.4

Current transformer secondary winding terminals shall be provided with short-circuiting links.

9.6.16.5

The current transformer for the neutral-earth connection shall be located in a separate terminal box for HV and in the main terminal box for LV.

9.6.17 Tap changers

9.6.17.1 De-energized tap-changer (DETC)

9.6.17.1.1

Manually operated de-energized tap-changers shall have a tapping range of ± 5 % in steps of 2,5 %.

9.6.17.1.2

Manually operated de-energized tap changers shall be provided with a steel operating handle.

9.6.17.1.3

Manually operated de-energized tap-changers shall be pad lockable in each position.

9.6.17.1.4

Manually operated de-energized tap-changers shall allow operation without the use of tools.

9.6.17.1.5

Manually operated de-energized tap-changers shall have a handle to operate all phases simultaneously.

9.6.17.1.6

Manually operated de-energized tap-changers for dry type transformers shall have bolted links.

9.6.17.2 On-load tap-changer (OLTC)

9.6.17.2.1

The diverter switch oil compartment shall be connected to a separate conservator or segregated section of the main conservator of the transformer.

9.6.17.2.2

Provisions shall be made for equalizing the vacuum in main tank and OLTC tank.

9.6.17.2.3 Diverter switch oil compartment

9.6.17.2.3.1

The diverter switch oil compartment shall have an oil sampling connection at bottom of the compartment.

9.6.17.2.3.2

The diverter switch oil compartment shall have a filling/filter connection valve and one drain/filter connection valve.

9.6.17.2.3.3

The diverter switch oil compartment shall have a dehydrating breather.

9.6.17.2.3.4

The diverter switch oil compartment shall have a liquid-flow controlled relay.

9.6.17.2.4 Motor drive mechanism

9.6.17.2.4.1

The motor drive mechanism shall have direction of rotation protection.

9.6.17.2.4.2

The motor drive mechanism shall have a lockable isolating switch.

9.6.17.2.4.3

The motor drive mechanism shall have local control facilities.

9.6.17.2.4.4

The motor drive mechanism shall have individual fault indications with two sets of common single-pole double-throw, dry-type contacts.

9.6.17.3 Remote control panel for on-load tap changer

9.6.17.3.1

The degree of protection shall be in accordance with general requirements specified in 9.6.1.

9.6.17.3.2

The master/follower method of controlling two or more transformers operating in parallel shall be applied.

9.6.17.3.3

The tap changer shall be controllable from the remote control panel.

9.6.17.3.4

The remote control panel shall be provided with an automatic, solid-state voltage regulator relay with the following provisions:

– an adjustable set point;

– selectable time characteristics;

– under-voltage and over-current blocking;

– a tap position indicator;

– tap change in progress indication;

– tap changer fault indication.

9.6.17.3.5

The remote control panel shall be provided with an anti-condensation heater.

9.6.18 Surface preparation, galvanizing and finishing

9.6.18.1

The supplier's standard paint system applied to the transformer shall provide protection against the climatic conditions specified in 4.2 f).

9.6.18.2

The finish of the internal walls of the tank, covers, connecting boxes and cooling systems shall protect against the effects of corrosion and the influence of the insulating liquid used in the transformer.

9.6.18.3

The tank and radiator material along with the fixing hardware shall have surface treatment in accordance with the category of corrosivity specified.

9.6.19 Markings

Transformers and their accessories shall be clearly marked to facilitate assembly and erection at site.

Add new subclause

9.7 Operating manual

9.7.1

The co-relation between nitrogen pressure and top liquid temperature shall be included in the operating manual.

9.7.2

A table indicating liquid levels at different top liquid temperatures shall be included in the operating manual.

11 Tests

11.1 General requirements for routine, type and special tests

11.1.2 Routine tests

11.1.2.1 Routine tests for all transformers

Add before list item a)

The following routine tests shall be performed:

Add new list item k)

k) Measurement for the dissipation factor (tan δ) of the insulation system capacitances.

Add new list item l)

l) Measurement for the d.c. insulation resistance each winding to earth and between windings.

Add new list item m)

m) Measurement for the dissolved gasses in dielectric liquid.

Add new list item n)

n) Visual and functional check of the various components and accessories of the transformer.

11.1.4 Special Tests

Add new list item q)

q) For a transformer feeding a single motor where there is no short-circuit type test certificate for an identical transformer, the following sequential tests shall be conducted:

1) three simulated transformer/motor on-load start tests with a current corresponding to the motor starting current and the transformer at its normal operating temperature;

2) measurement of reactance at normal operating temperature;

3) measurement of reactance after the simulated starts.

On-load start test duration shall be equal to the running-up time of the motor.

The measured reactance value shall not deviate by more than 2 % from the value prior to testing.

12 Electromagnetic compatibility (EMC)

Add to clause

Accessories shall conform to IEC 61000-6-2 and IEC 61000-6-4 for industrial type installations, for both immunity and emissions.

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