



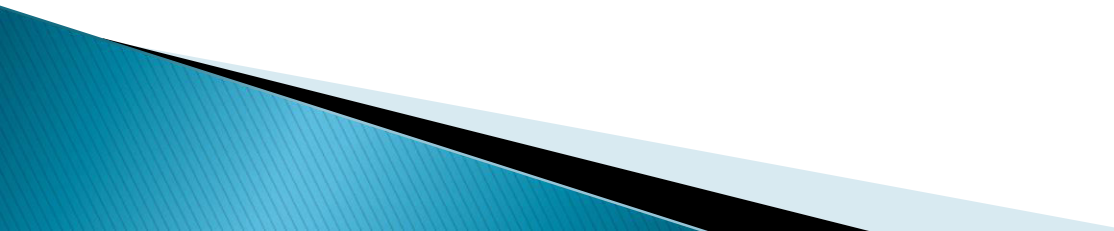
PRESENTATION ON IS 1180 (Part 1): 2014 DISTRIBUTION TRANSFORMERS



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BUREAU OF INDIAN STANDARDS**

OVERVIEW

BUREAU OF INDIAN STANDARDS

- Bureau of Indian Standards (BIS) is the NATIONAL STANDARD BODY.
 - Established under the BIS Act 1986 for the harmonious development of the activities of standardization, marking and quality certification of goods
 - New BIS Act 2016 has also been passed by the Parliament.
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BIS is involved in various activities as given below:

a. **STANDARDS FORMULATION**

b. Product Certification Scheme

c. Compulsory Registration Scheme

d. Foreign Manufacturers Certification Scheme

e. Hall Marking Scheme

f. Laboratory Services

g. Laboratory Recognition Scheme

h. Sale of Indian Standards

i. Consumer Affairs Activities

j. Promotional Activities

k. Training Services, National & International level

l. Information Services



Areas of Standardization

Chemical

Civil
Engineering

Electronics and
Information
Technology

Electrotechnical

Food and
Agriculture

Management
and Systems

Mechanical
Engineering

Medical
Equipment and
Hospital Planning

Metallurgical
Engineering

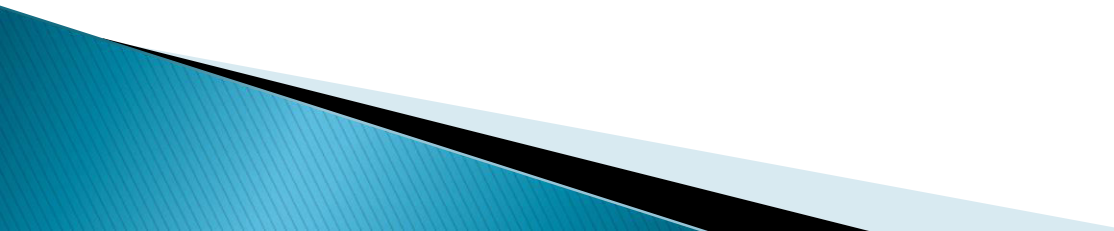
Petrochemical,
Coal & Related
Products

Production and
General
Engineering

Textiles

Transport
Engineering

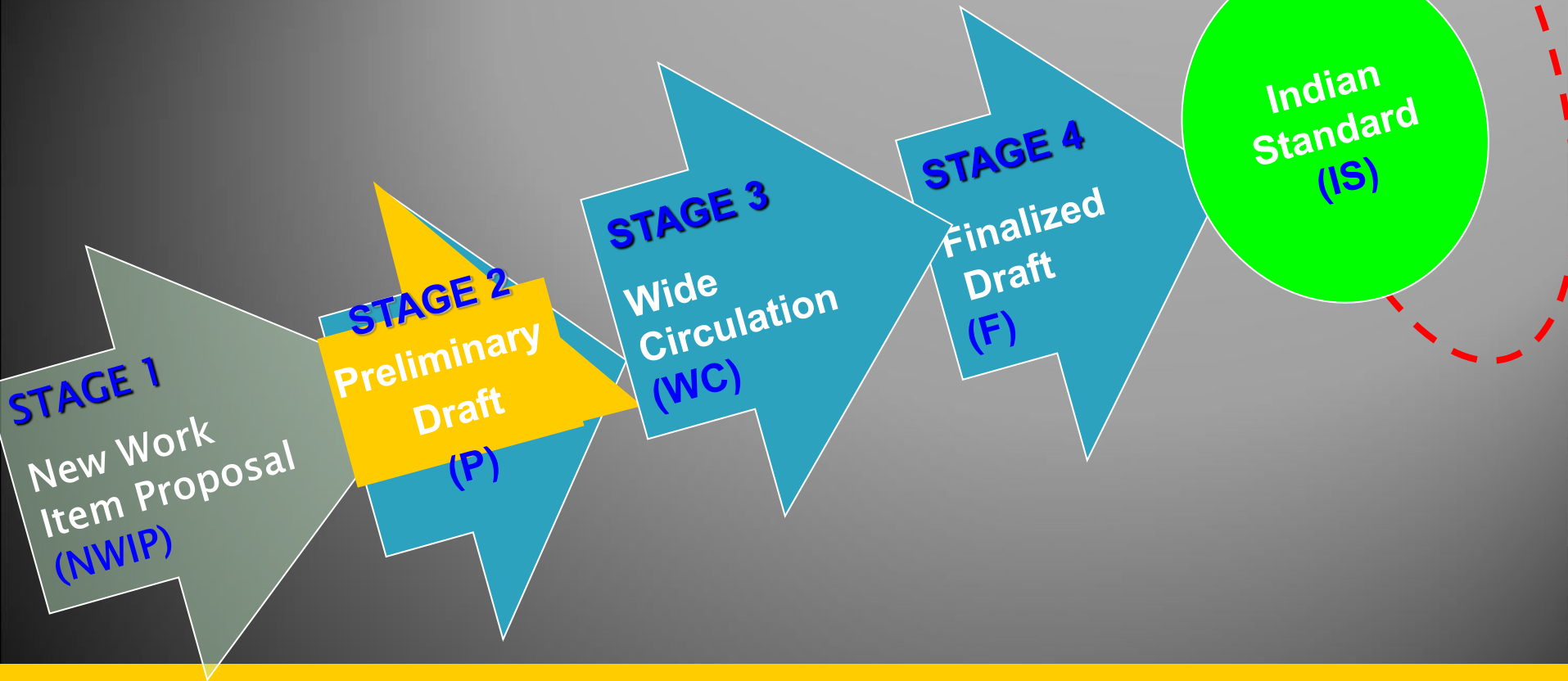
Water
Resources

- Indian Standards developed through technical committees involving all concerned Stakeholders.
 - Presently, there are 43 technical committees working under the Electrotechnical Division Council.
 - Transformers Sectional Committee, ETD 16 is one of these technical committees formulating Standards related to Transformers.
 - Decisions in BIS technical committees are reached through consensus.
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COMPOSITION OF STANDARD FORMULATION COMMITTEE



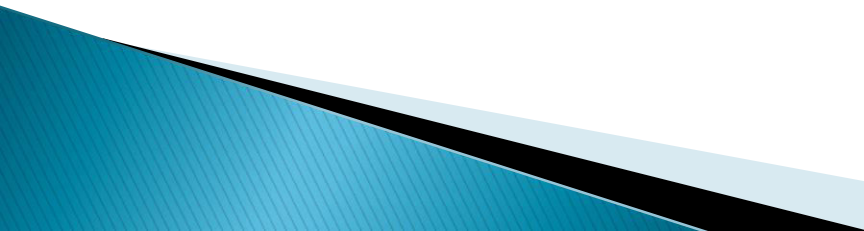
STAGES OF STANDARD FORMULATION



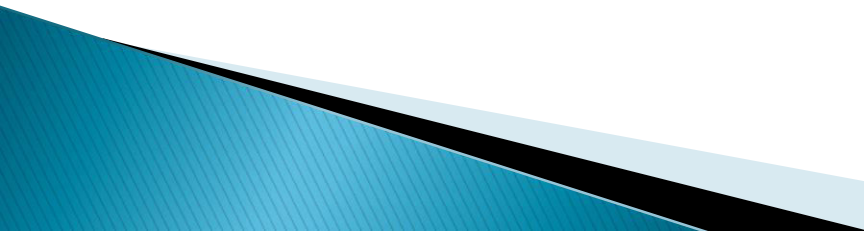
Stage 2 : Building consensus among committee members

Stage 3: Building national consensus

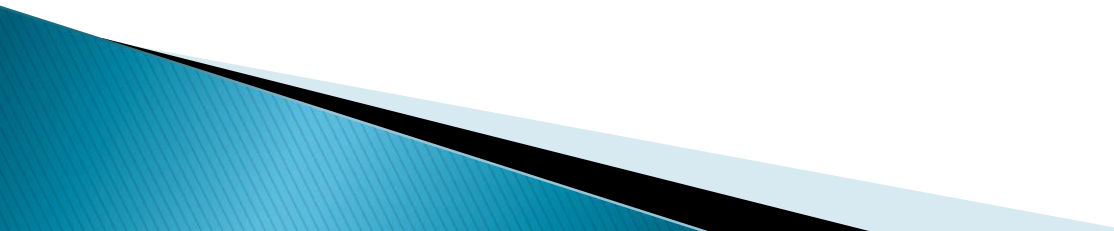
EARLIER INDIAN STANDARDS ON DISTRIBUTION TRANSFORMERS

- **IS 1180(Part 1): 1989** - Outdoor type three phase distribution transformers upto and including 100kVA 11 kV Part 1: Non sealed type.
 - **IS 1180(Part 2): 1989** - Outdoor type three phase distribution transformers upto and including 100kVA 11 kV Part 2: Sealed type.
 - Scope was limited upto three phase 100 kVA, 11kV.
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IS 1180 (PART 1) : 2014

- IS1180 (Part 1) has been revised by taking into account the needs of various stakeholders and technological developments taken place on transformer.
 - Title of IS 1180 (Part 1) : 2014 — Outdoor/Indoor Type Oil Immersed Distribution Transformers Up to and Including 2 500 kVA, 33kV — Specification: Part 1 Mineral Oil Immersed (Fourth Revision).
 - Two amendments have been published.
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SALIENT FEATURES OF IS 1180(Part 1): 2014

- Includes Outdoor type as well as Indoor type three phase Distribution Transformers upto and including 2500 kVA with nominal system voltage upto and including 33 kV (both sealed and non-sealed).
 - Includes Single phase Distribution Transformers upto and including 100 kVA (sealed type).
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➤ Following types of transformers are not covered:

- a) Inverter duty transformers;
- b) Traction transformers;
- c) Instrument transformers;
- d) Transformers for static converters;
- e) Starting transformers;
- f) Testing transformers;
- p) Rectifier transformers; and
- h) Earthing transformers;
- g) Welding transformers;
- j) Mining transformers;
- k) Transformers for solar, wind power application;
- m) Transformers for railways (locomotive and other applications);
- n) Furnace transformers;
- q) Dual ratio in primary/secondary windings transformers.

➤ relevant CEA guidelines must be followed while using mineral oil filled DT's indoor.

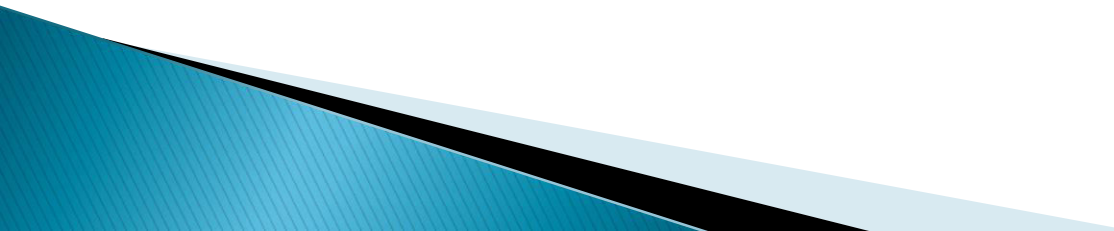
➤ In case of indoor transformers and transformers installed in an enclosure, suitable ventilation, if required, shall be provided to maintain service conditions as per IS 2026 (Part 1).

WHAT IS A DISTRIBUTION TRANSFORMER

A distribution transformer is a transformer that provides the final voltage transformation by stepping voltages down within a distribution circuit or from a distribution circuit to an end user or application.

NOTE — The distribution circuit voltages are 3.3 kV, 6.6 kV, 11 kV, 22 kV and 33 kV in the country. The power supply for the end users is 415 volt, 3 Phase (240 volt, 1 phase), 50 Hz. Transformers with primary voltages of 3.3, 6.6, 11, 22 or 33 kV and secondary voltage of 433 volt, 3 Phase (and 250 volt single phase) are called Distribution Transformers. The maximum rating of these transformers for the purpose of this standard is considered up to 2 500 kVA, 3 Phase.

SERVICE CONDITIONS

- Service conditions shall be as per IS 2026 (Part 1) : 2011.
 - In case of indoor transformers and transformers installed in an enclosure, suitable ventilation, if required, shall be provided to maintain service conditions as per IS 2026 (Part 1).
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RATINGS

a) Three phase distribution transformers

Sl No.	Nominal System Voltage	Standard Ratings (kVA)
1.	Up to and including 11 kV	*6.3, *10,16, *20, 25, *40, 63, 100, 160, 200, 250, 315, 400, 500, 630, 800, 1 000, 1 250, 1 600, 2 000 and 2 500
2.	Above 11 kV up to and including 22 kV	63, 100, 160, 200, 250, 315, 400, 500, 630, 800, 1 000, 1 250, 1 600, 2 000 and 2 500
3.	Above 22 kV up to and including 33 kV	100, 160, 200, 250, 315, 400, 500, 630, 800, 1 000, 1 250, 1 600, 2 000 and 2 500

Note: * ratings are non preferred.

b) Single phase distribution transformers

Sl No.	Nominal System Voltage	Standard Ratings (kVA)
1.	11 kV	5, 10, 16, 25, *50, *75 & *100
2.	22 kV	10, 16, 25, *50, *75 & *100
3.	33 kV	16, 25, *50, *75 & *100

Note: * ratings are non preferred.

BASIC INSULATION LEVEL

- Basic insulation level values given are **MINIMUM VALUES**.

NOTE: Insulation coordination of all relevant fittings and accessories corresponding to higher BIL values shall be ensured.

- a) For three phase DTs

Sl No. (1)	Nominal System Voltage (kV) (2)	Minimum BIL (kVp) (3)
1.	3.3	40
1.	6.6	60
1.	11	75
1.	22	125
1.	33	170

➤ b) For single phase DTs

Sl No. (1)	Nominal System Voltage (kV) (2)	Minimum BIL (kVp) (3)
1.	11	75
1.	22	125
1.	33	170

TAPPINGS

- No taps are generally required upto 100 kVA, unless specified.
- Standard tapping range is given below:

Transformer range	No. of tap positions	Voltage variation
3 phase transformers upto and including 200 kVA	4	+2.5% to -5% of HV in steps of 2.5 percent
3 phase transformers higher than 200 kVA and upto and including 2500 kVA	7	+5% to -10% of HV in steps of 2.5 percent for variation of HV

NOTE: 1) For ratings 500 kVA and above, on load tap changers may be provided for variation of HV voltage from +5 percent to -15 percent in steps of 2.5 percent
2) Off-circuit tap-changing is permitted

- Provision of any other tapping range and tapping step is subject to agreement between the user and the supplier

LOSSES

➤ Losses given in Table 3, Table 6 and Table 9 are **MAXIMUM TOTAL LOSSES**

➤ These losses are only for transformers upto 11kV voltage class

➤ For 22 kV and 33 kV class higher losses values permitted (as given in the next slide)

➤ Losses for non-preferred ratings have been added through amendment.

➤ Maximum total losses for voltage class above 11 kV is given in table below:

Voltage class	Maximum total losses for 3 phase transformers upto and including 200 kVA	Maximum total losses for 3 phase transformers higher than 200 kVA and upto and including 2500 kVA	Maximum total losses for single phase transformers upto and including 25 kVA
Above 11 kV and upto and including 22 kV	Shall not exceed by 5% of the maximum total losses given in Table 3	Shall not exceed by 5% of the maximum total losses given in Table 6	Shall not exceed by 7.5% of the maximum total losses given in Table 9
Above 22 kV and upto and including 33 kV	Shall not exceed by 7.5% of the maximum total losses given in Table 3	Shall not exceed by 7.5% of the maximum total losses given in Table 3	Shall not exceed by 10% of the maximum total losses given in Table 3

LIMITS OF TEPERATURE RISE

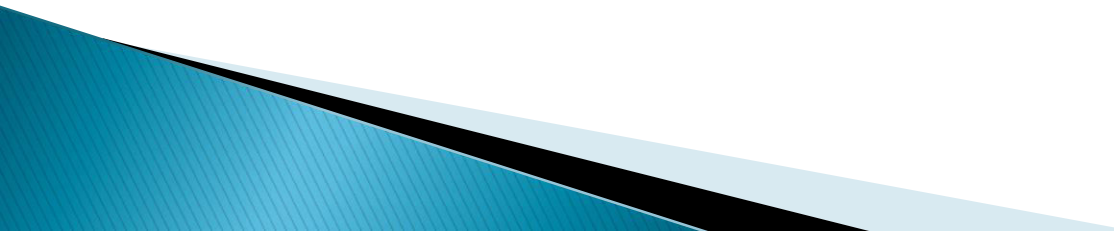
➤ Limits are given as below:

Transformer class	Limits for temperature rise
3 phase transformers upto and including 200 kVA	For transformer winding - 40°C (when measured by resistance method) For top oil - 35°C (measured by thermometer)
3 phase transformers higher than 200 kVA and upto and including 2500 kVA	For transformer winding - 45°C (when measured by resistance method) For top oil - 40°C (measured by thermometer)
single phase transformers upto and includng 25 kVA	For transformer winding - 40°C (when measured by resistance method) For top oil - 35°C (measured by thermometer)

➤ These are **maximum limits of temperature rise.**

➤ Lower temperature rise limits are acceptable but it might increase the cooling equipment cost.

% IMPEDENCE VALUES

- Values of % impedance given in IS 1180 (Part 1) : 2014 are only **RECOMMENDED VALUES**.
 - Manufacturers can prefer other values while designing.
 - Higher impedance values might lead to poor regulation, more stray losses and heating, therefore small variation in these values is suggested.
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STANDARD MATERIALS

Major material used in the transformer shall conform to the following Indian Standards:

- a) Cold rolled grain oriented electrical steel – IS 3024
- b) Amorphous core material – (IS 16585)
- c) Copper/Aluminum conductor – IS 191, IS 1897, IS 7404, IS 12444, IS 13730/IS 6162 series as given in Annex A.
- d) Kraft paper – IS 9335 series as given in Annex A.
- e) Press board – IS 1576
- f) f) Mineral oil – IS 335

NOTE — Use of other insulating liquids namely natural ester, synthetic organic ester IS 16081 subject to agreement between the user and the supplier

MOUNTING ARRANGEMENT

➤ Mounting arrangement is given in cl 14:

a) Upto 200 kVA:

- two channels of minimum size 75 mm × 40 mm shall be provided.
- Note added under Fig. 6 – Any other mounting dimensions are subject to agreement between the user and the supplier.

b) Beyond 200 kVA

- Bidirectional rollers can also be used as per mutual agreement between the user and the supplier.
- Any other mounting dimensions are subjected to agreement between the user and the supplier.'

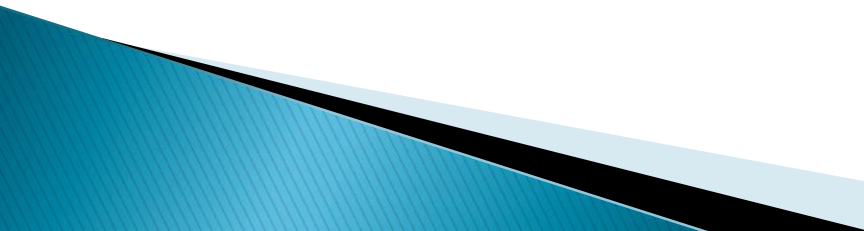
➤ Suitable pole mounting arrangement may be alternatively provided for 3 phase transformers upto 500 kVA, subject to agreement between user and supplier.

➤ Single phase transformers are pole mounted type and shall be provided with two mounting lugs suitable for fixing the transformer to a single pole by means of two bolts of 20 mm diameter. Both mounting lugs are made with steel of minimum 5 mm thickness.

PAINT THICKNESS

- Measuring Paint Thickness is not a part of the tests specified in IS 1180 (Part 1).
- This is for guidance to the stakeholders. It is to be ensured by the Inspecting agencies at the time of factory visit.

CONSTRUCTION REQUIREMENTS FOR TRANSFORMER TANK

- Given under clause 15.
 - Minimum thickness at the corrugations shall be 1.0 mm
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STANDARD FITTINGS given under clause 20.1

➤ These fittings shall be provided by the manufacturer.

- a) Two earthing terminals with the earthing symbol \perp ;
- b) Oil level gauge indicating oil level at minimum, 30°C and maximum operating temperature;

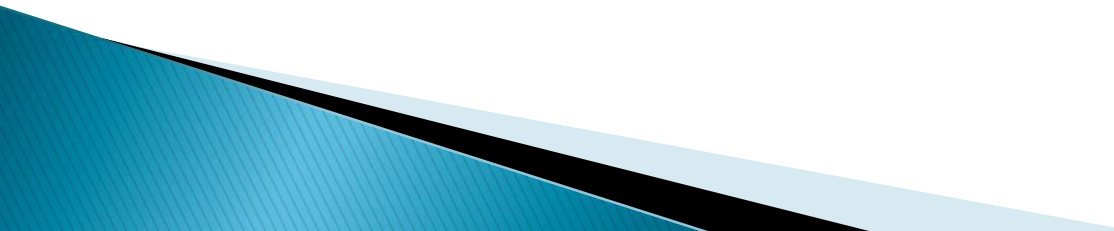
NOTES

1 Minimum and maximum positions correspond to the operating temperature of -5°C and 90°C respectively (for non-sealed type transformer).

2 Only minimum position corresponding to the operating temperature of 30°C (for sealed type transformers).

- c) Air release device (for non-sealed type transformers);
- d) Rating and terminal marking plates;
- e) Dehydrating breather shall be provided for non-sealed type transformers;
- f) Drain-cum-sampling valve preferably steel with plug for three phase transformers (for ratings above 500 kVA);

NOTE — Valve size shall be as per agreement between the user and the supplier.

- g) Thermometer pocket with cap;
 - h) Oil/Nitrogen/Air filling hole having (1¼" nominal size thread) with cover (for sealed type transformers without conservator);
 - j) Lifting lugs for the complete transformer as well as for core and winding assembly;
 - k) Pressure relief device or explosion vent [for sealed type transformers (for all ratings) and non-sealed type transformers (for ratings above 200 kVA)];
 - m) One filter valve on the upper side of the tank (for transformers above 200 kVA);
 - n) HV side neutral grounding strip (where one of the HV bushing terminal is connected to earth);
 - p) LV earthing arrangement for single phase transformers;
 - q) Buchholz relay for transformers above 1 000 kVA; and
 - r) Arcing horns for HT side (one number per phase).'
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OPTIONAL FITTINGS given under clause 20.2:

➤ These fittings may be provided at the option of the user wherever specified.

a) Dehydrating breather in lieu of plain breathing device for transformers up to 200 kVA;

b) Filter valve for transformers up to 200 kVA;

NOTE — Valve size shall be as per agreement between the user and the supplier.’

a) Suitable rating lightning arrestors for HT side (one number per phase);’

b) Bird guard;

c) Terminal connectors

d) Oil temperature indicator and winding temperature indicators for transformers above 200 kVA;

e) Jacking pads (for transformer above 1 600 kVA);

f) Buchholz relay (for transformers above 200 kVA);

j) Magnetic oil level gauge (for transformer above 1 600 kVA) with low oil level alarm contact;

- k) Non return valve (for conducting pressure test);
- m) Pressure relief device or explosion vent (upto 200 kVA for non-sealed type transformers);
- ‘n) Protection relay for sealed type transformers for internal parameters that is pressure, temperature, oil level and gas detection;’
- p) 4 Nos anti-theft stainless steel fasteners with breakaway nut shall be provided at top cover (up to 200 kVA). NOTE — IS 3639 describes some of the fittings and accessories.
- q) Unidirectional flat rollers (for transformers above 200 kVA);
- r) Drain-cum-sampling valve preferably steel with plug for three phase transformers (for transformers upto 500 kVA); and NOTE — Valve size shall be as per agreement between the user and the supplier.
- s) **Self protection/disconnection devices** subject to agreement between the user and the supplier:
 - 1) Thermo-magnetic circuit breaker as self protection device on secondary side as per IS/IEC 60947-2 : 2003; and
 - 2) Expulsion fuse as disconnection device on primary side as per IS 9385 (Part 2) : 1980.

NOTE— Additional requirements for transformers with self protection/disconnection devices are under preparation.

TEST REQUIREMENTS

All routine, type and special tests as described in 21.2 to 21.4 shall be performed as per relevant parts of IS 2026.

➤ **ROUTINE TESTS (to be conducted on all units)**

- a) Measurement of winding resistance [IS 2026 (Part 1)].
- b) Measurement of voltage ratio and check of phase displacement [IS 2026 (Part 1)].
- c) Measurement of short-circuit impedance (principal tapping, when applicable) and load loss at 50 percent and 100 percent load [IS 2026 (Part 1)].
- d) Measurement of no-load loss and current [IS 2026 (Part 1)].
- e) Measurement of insulation resistance [IS 2026 (Part 1)].
- f) Induced over-voltage withstand test [IS 2026 (Part 3)].
- g) Separate-source voltage withstand test [IS 2026 (Part 3)].

Note: For single phase transformer with $11/\sqrt{3}$ or $22/\sqrt{3}$ or $33/\sqrt{3}$ kilo volts and with 1.0 kV neutral bushing, this test shall be conducted at test voltage of neutral (3 kV rms for one minute).'

- h) Pressure test (see 21.5). j) Oil leakage test (see 21.5).

➤ **TYPE TESTS (to be conducted on one unit)**

- a. Lightning impulse test [IS 2026 (Part 3)].
- b. Temperature-rise test [IS 2026 (Part 2)].
- c. Short-circuit withstand test [IS 2026 (Part 5)] (up to 200 kVA).

NOTE — Routine tests before and after short circuit test shall be conducted as per IS 2026 (Part 1).

- a. Pressure test – requirements given for both single phase as well as three phase transformers.

- i. **Upto 200 kVA:**

Test requirements for corrugated tanks added

Limits of deflection given.

Permanent deflection is not applicable for corrugations

- ii. **Beyond 200 kVA**

Test requirements for corrugated tanks added

Limits of deflection given.

Permanent deflection is not applicable for corrugations

➤ Additional information on leakage test has been provided in ANNEX E

c) SPECIAL TESTS (to be conducted on one unit)

- a) Determination of sound levels [IS 2026 (Part 10)]
- b) Short-circuit withstand test [IS 2026 (Part 5)] (above 200 kVA) NOTE — Routine tests before and after short circuit test shall be conducted as per IS 2026 (Part 1).
- c) No load current at 112.5 percent voltage (see 5.9.3).
- d) Paint adhesion tests. The test is performed as per ASTM D3359 (Standard Test Methods for measuring adhesion by Tape test).
- e) BDV and moisture content of oil in the transformer (IS 335).

NOTE — Tests at (d) and (e) may be carried out on more than one unit subject to agreement between user and supplier.

➤ These are subject to agreement between user and supplier



METHOD OF DECLARING EFFICIENCY

- The efficiency to be declared is the ratio of the output in kW to the input in kW and calculated as under.
- $$\text{Efficiency} = \frac{\text{output}}{\text{input}} = \frac{\text{input} - \text{total losses}}{\text{input}}$$
- Total losses comprise:
 - No-load loss, which is considered to be constant at all loads : and
 - Load loss, which varies with load.
- The total loss, on load is the sum of above losses.

NORMAL INFORMATION

The following information should be given in all cases:

- Particulars of the specification to be complied with;
- Application of Transformer e.g. normal Distribution Transformer, Solar duty, wind application, Motor starting etc.
- Single or three phase unit;
- Number of phases in system;
- Frequency;
- Indoor or outdoor type;
- Type of cooling;
- Rated power (in kVA)
- Rated voltages (for each winding);
- State if tappings are required and if on-load or off-circuit tap-changers, or links are required.
- Highest voltage for equipment (for each winding);
- Method of system earthing (for each winding);
- Insulation level (for each winding), power frequency test level/impulse level;
- Connection symbol;
- Neutral terminals, if required (for each winding) and their insulation level to earth;
- Special requirements of installation, assembly, transport and handling;
- Fittings required and an indication of the side from which meters, rating plates, oil-level indicator, etc. may be readable.

ADDITIONAL INFORMATION

- The following additional information may be required to be given:
- If a lightning impulse voltage test is required, whether or not the test is to include chopped waves [see IS 2026 (Part 3)].
- Impedance voltage at rated current, if specific value is required;
- Altitude above mean sea-level, if in excess of 1 000 m;
- Whether transformers will be subjected to frequent overcurrent, for example, furnace transformers and traction feeding transformers;
- Any other exceptional service conditions;
- Whether noise level measurement is to be carried out;
- Vacuum withstand of the transformer tank, if a specific value is required;
- Type of Tap-changer controls required (if OLTC is provided);
- Type of mounting for example pole mounted, ground mounted etc.
- Any other appropriate information, including reference to any special tests not referred to above which may be required.

THANK YOU