BIS PRESENTATION ON STANDARDS AND CERTIFICATION OF- DISTRIBUTION TRANSFORMERS

Sabyasachi Dhar
BUREAU OF INDIAN STANDARDS
Guwahati Branch Office

MILESTONES OF BIS

INDIAN STANDARDS INSTITUTION [Now known as Bureau of Indian Standards(BIS)] set up on 6 January 1947

- BIS is functioning under Ministry of Consumer Affairs, Food and Public Distribution, Govt of India as a statutory body under BIS Act, 1986 with effect from 1 April 1987
- National standards body of India
- Objectives
  - Harmonious development of standardization and quality control in national and international arena
  - Certification schemes for products and systems
  - Growth and development of Indian industry, commerce and exports
  - Consumer protection

BUREAU OF INDIAN STANDARDS

PRESIDENT
(Hon'ble Union Minister for Consumer Affairs, Food & Public Distribution)

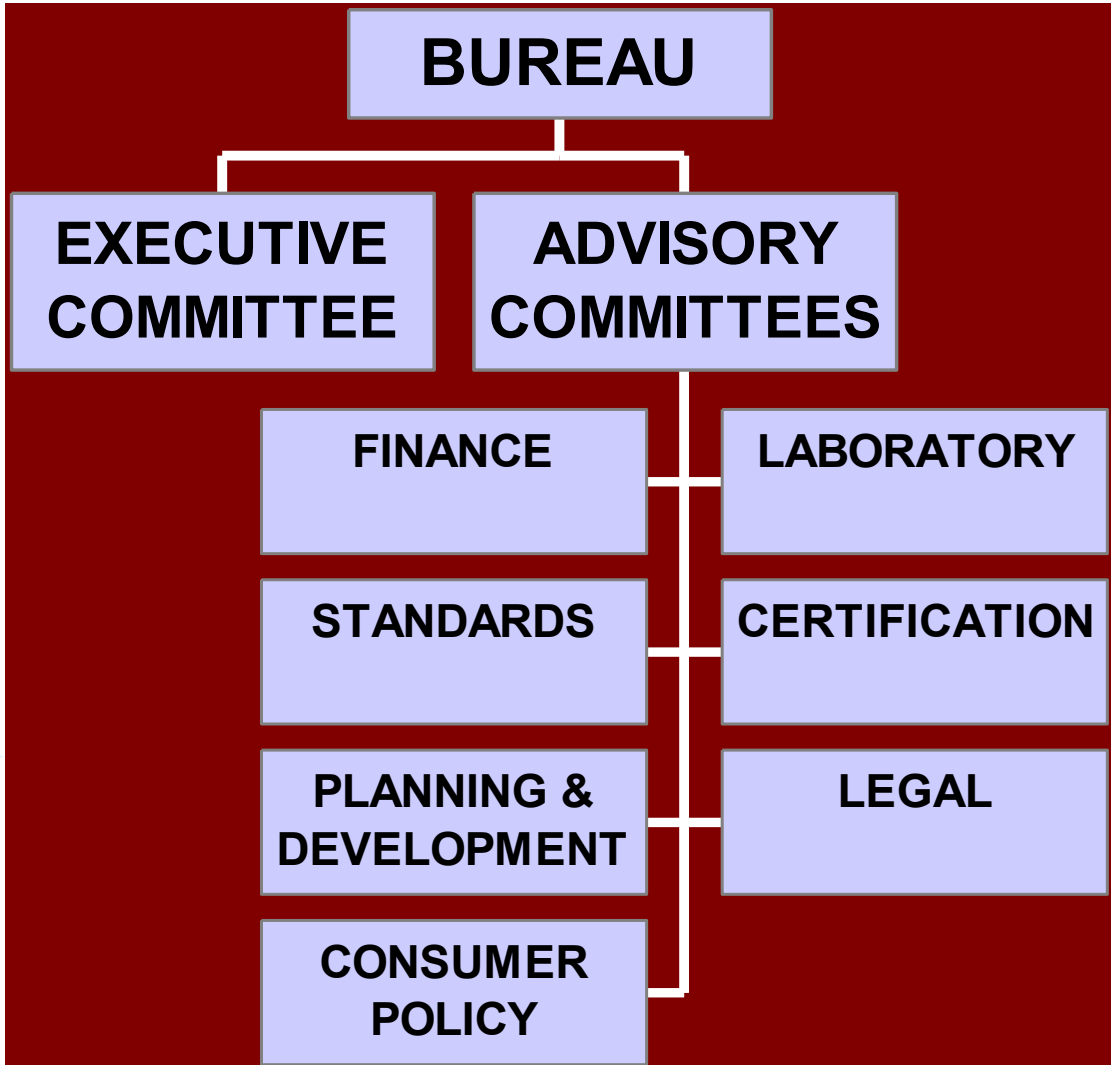
VICE PRESIDENT
(Hon'ble Minister of State for Consumer Affairs & Public Distribution)

BUREAU MEMBERS

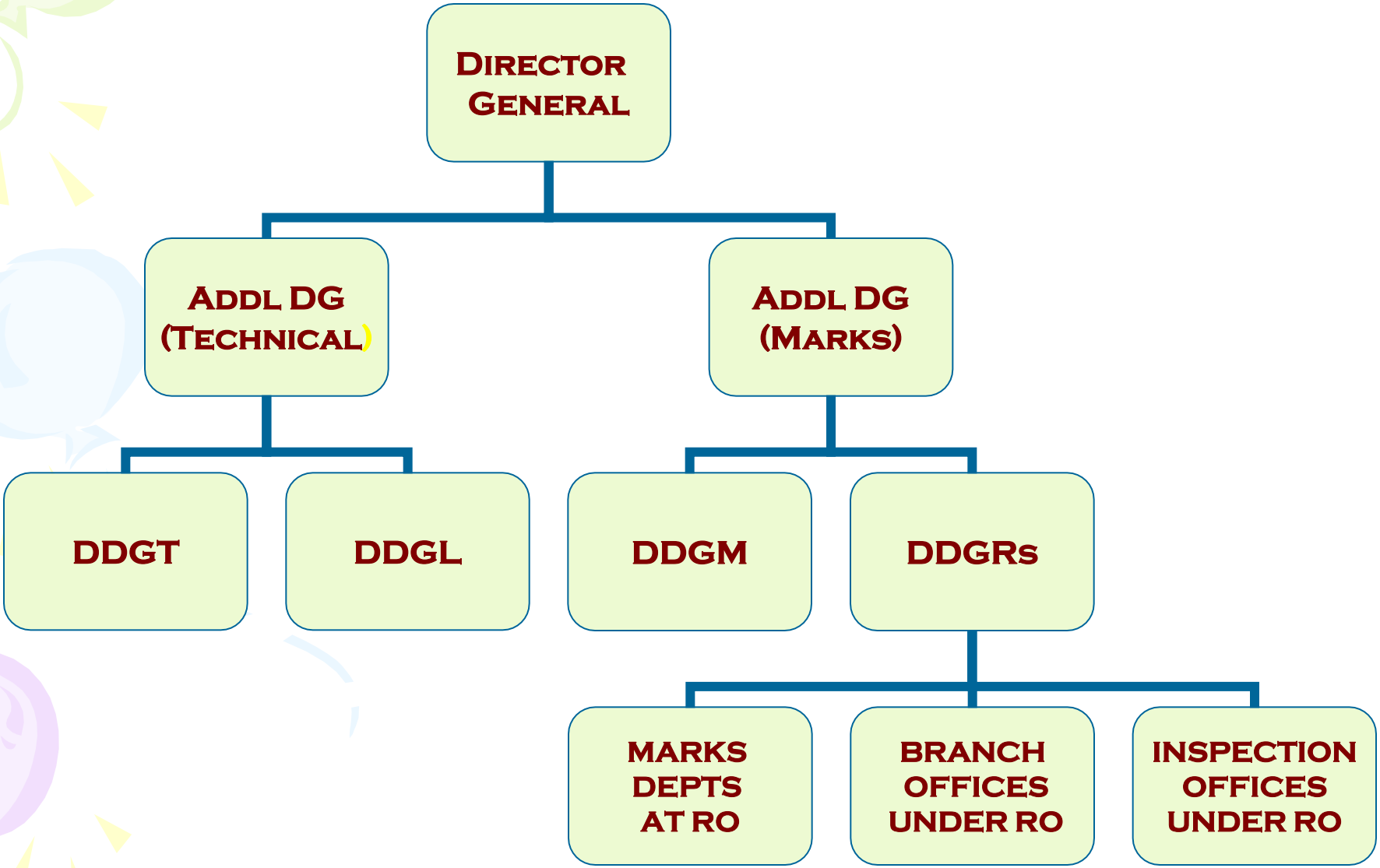
Members of Bureau

1. Members of Parliament
2. Persons representing the Ministries and Departments of Central Govt.
3. Representation from the State Govts and the Union Territories
4. Representatives of recognized Consumer Organizations and Persons representing Consumer Interests
5. Persons representing Farmers' Interests
6. Representatives of Industry/Small Scale Industry Associations or Federations
7. Representatives of Public Sector Enterprises
8. Representatives of Industrial Organizations other than Public Sector
9. Representatives of Small Scale Industrial Units
10. Representatives of Scientific and Research Institutions
11. Representatives of Technical, Educational and Professional Organizations

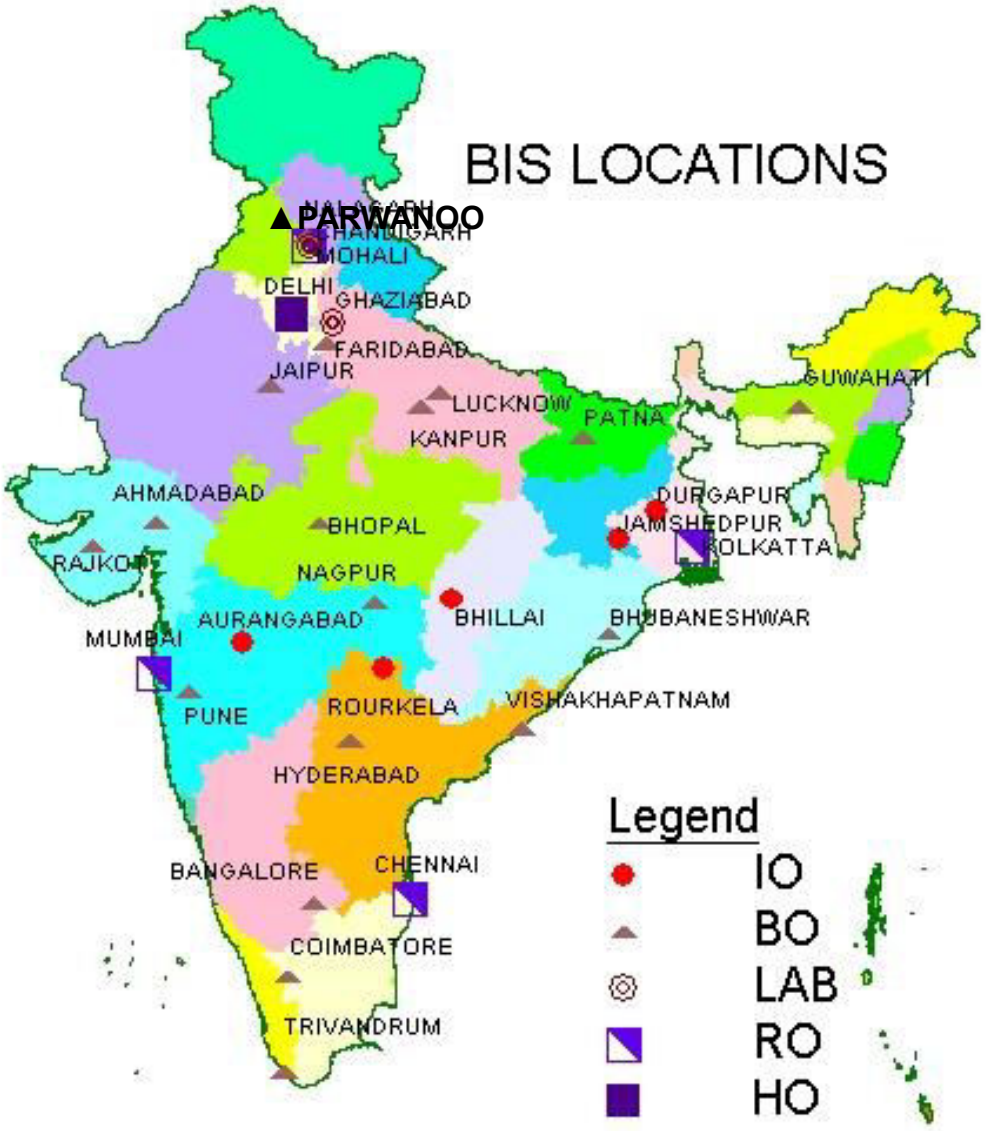
Bureau of Indian Standards



BIS ORGANIZATION CHART



HQ - Delhi
5 Regional Offices
33 Branch Offices in 24 locations
5 Inspection Offices
8 Labs



Main Activities

- Standards Formulation
- Certification
  - Product
  - Hallmarking of Gold Jewellery
  - Quality Management System
  - Environmental Management Systems
  - Occupational Health and Safety Management System
  - Food Safety Management System
  - Hazard Analysis and Critical Control Points
  - Imported Products
- Laboratory Management
- International Activities
- Training Services
- Others
  - Information Services
  - Consumer Affairs & Standards Promotion
  - Sale of Standards

STANDARDIZATION

- IS 1180 (PART 1) – OUTDOOR/INDOOR TYPE OIL IMMERSED DISTRIBUTION TRANSFORMERS UPTO AND INCLUDING 2500 KVA, 33KV ,MINERAL OIL IMMERSED

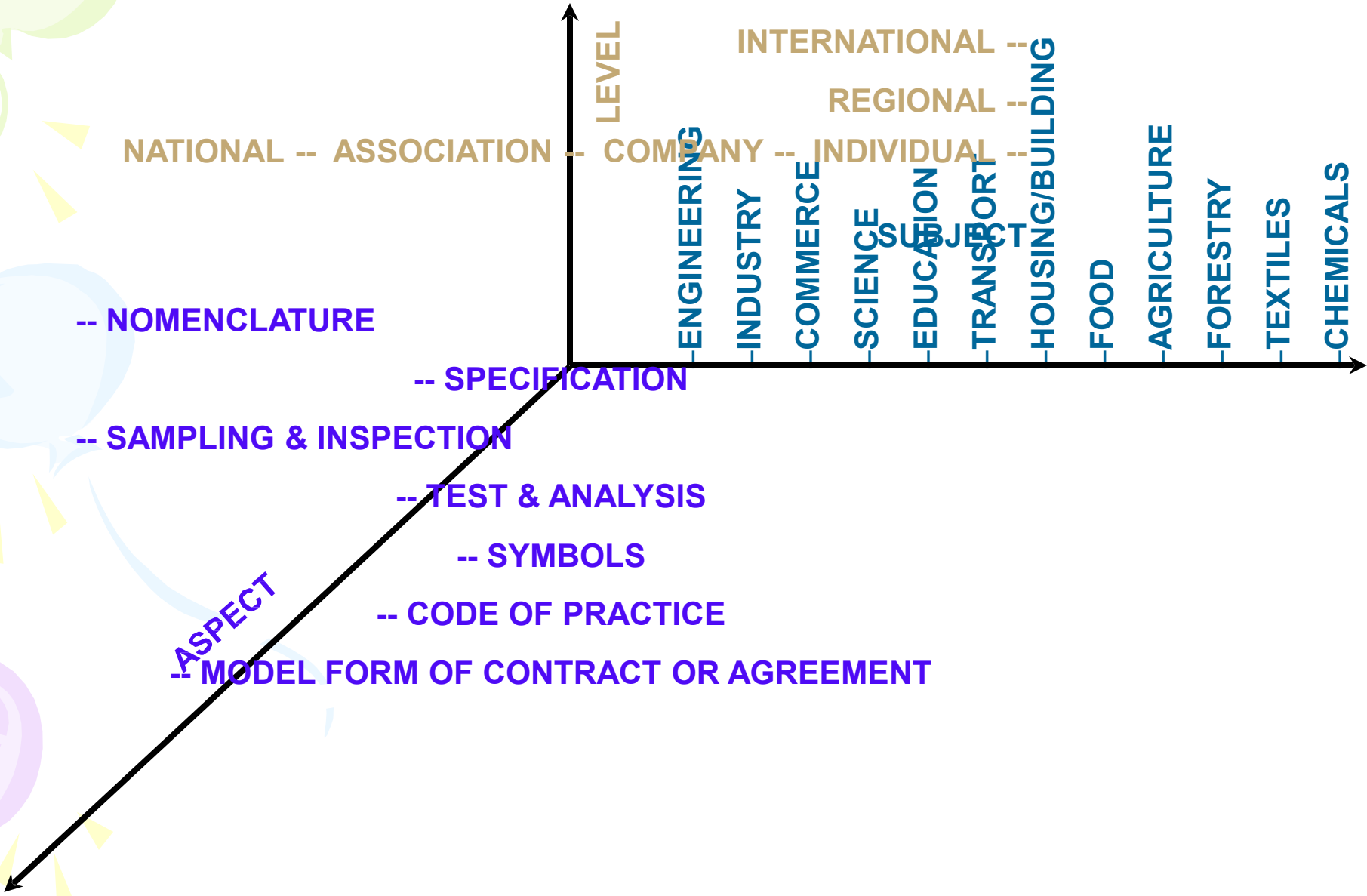
Focus of The Presentation

- Objectives of BIS
- Process of developing Standardization culture Involvement of all concerned in the process of Standardization through consensus
- Need for developing/improvement in Standards on distribution transformers
- Areas covered in Standard of distribution transformers
- Thrust on new areas as well as enhancement of the scope of the earlier version of distribution transformers
- Need to give wider coverage in key area of activities

OBJECTIVES

- Harmonious development of
  - Standards
  - Marking
  - Quality Certification
- Provide new thrust to
  - Standardization
  - Quality Control
- To evolve a National Strategy for according recognition to standards and integrating them with growth and development of production and exports

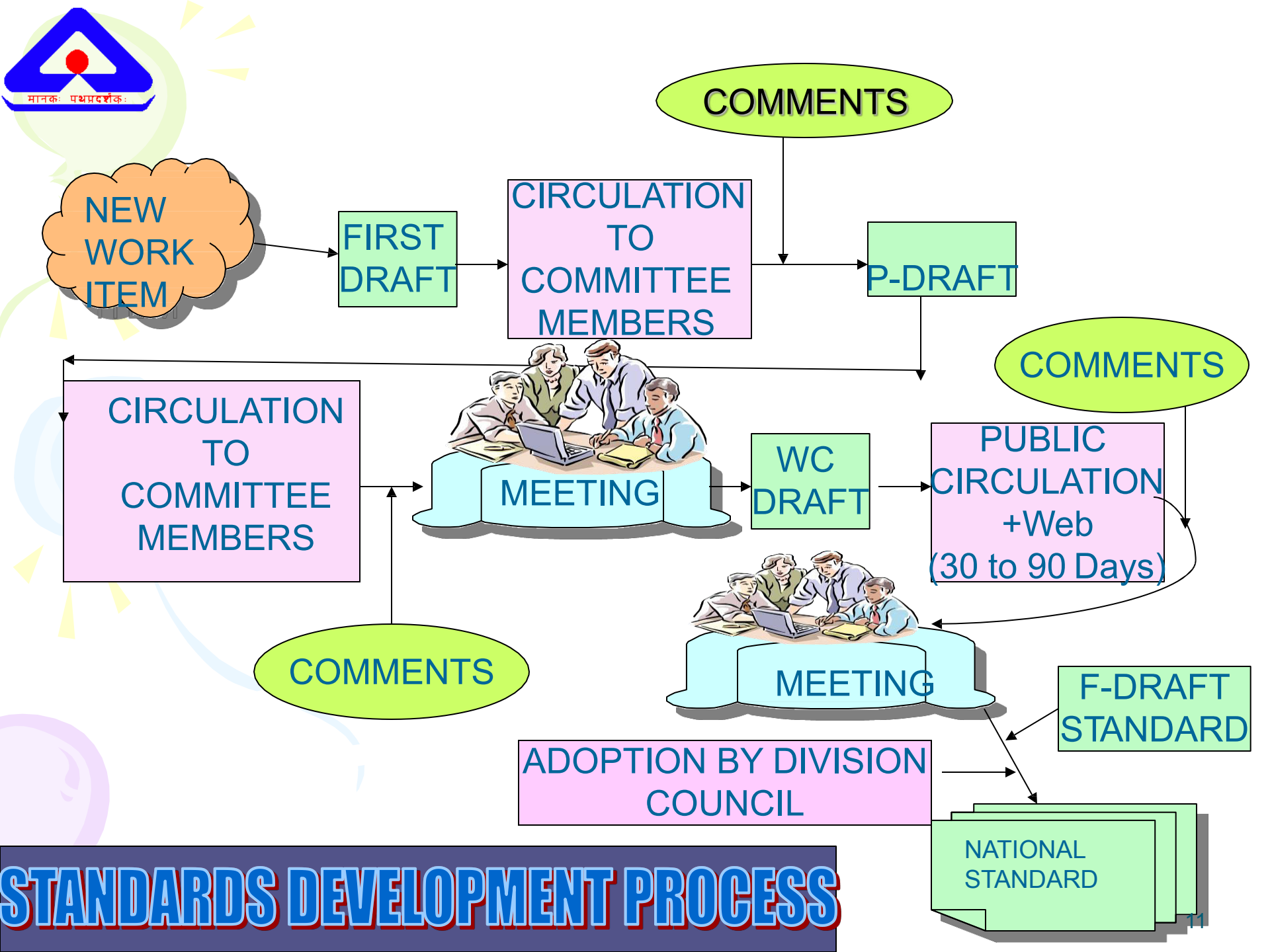
STANDARDIZATION SPACE



STANDARDIZATION SET UP

- Standard formulation activity of Bureau is functioning under Standard Advisory Committee.
- There are 14 Technical Sectors under SAC and each of these sector has a Division Council (ETDC, LITDC etc.)
- Electro technical Division Council(ETDC) is responsible for national standardization in the field of Electrotechnology.


COMPOSITION
of
STANDARD
FORMING
COMMITTEE
Chairman (Independent Body)
Member Secretary (BIS)
Manufacturer
Laboratories/ R&D Institutions
Government & Regulatory Bodies
Consumer/ User Organization
Industry Association
Public Sector Units
Consulting Firms
Professional & Academic Bodies



STANDARDS DEVELOPMENT PROCESS

BASIC CONSIDERATIONS IN EVOLVING STANDARDS

- Consensus Principle
- Access to International Technology
- Research & Development
- Availability of indigenous materials & technology
- Co-ordination with other Levels of Standardization
- Consultations involving all Stakeholders
- Documents sent for public comments before finalization & also hosted on BIS web site

Standards are developed with following in mind

- Safety
- Ease of use and adaptability
- Simple Technology
- Value for money products
- Energy Efficiency & Environment

ELECTROTECHNICAL DIVISION COUNCIL

- 39 Sectional Committees addressing the diverse standardization needs of the Nation in the field of Electrotechnology.
- Number of Indian Standards 1467
- **Harmonized with IEC/ISO standards**

- Dual No.(IS/IEC.. : ..) 351
- Technically equivalent 411

(IS and IEC with |)

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.

REVISED VERSION OF IS ON DISTRIBUTION TRANSFORMERS

- IS 1180(Part 1): 2014 - Outdoor/Indoor type, insulated liquid immersed Distribution Transformers upto and including 2500 kVA, 33kV (Part 1: Mineral Oil Immersed)

SCOPE

- SPECIFIES REQUIREMENTS AND TESTS INCLUDING STANDARD LOSS LEVELS OF MINERAL OIL IMMERSED, NATURAL AIR COOLED, OUTDOOR/INDOOR TYPE, DOUBLE WOUND DISTRIBUTION TRANSFORMERS FOR USE IN POWER DISTRIBUTION SYSTEMS WITH NOMINAL SYSTEM VOLTAGES UPTO AND INCLUDING 33Kv AND OF FOLLOWING TYPES AND RATINGS:

Contd....

- a) Three Phase ratings upto and including 200KVA both non sealed type and sealed type.
- b) Three Phase ratings higher than 200KVA upto and including 2500KVA both non sealed type and sealed type.
- Single Phase ratings upto and including 100KVA sealed type.

Distribution Transformers

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

(*Page* 1, *clause* **1**) — Insert the following as Notes at the end:

NOTES

1 The following types of transformers are not covered under the scope of this standard:

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

2 For Indoor Type Distribution Transformers, relevant provisions of Central Electricity Authority (CEA) Regulations, if applicable.

(*Page* 1, *clause* **3.1**) — Substitute following in place of existing clause:

Non Sealed Type Transformers

- A transformer which has a breather for breathing out and breathing in and /or a conservator with expansion and contraction of oil with temperature. The transformer tank body and cover are bolted / clamped / welded type. The tank can also be of corrugated construction.

Sealed Type Transformers

- A transformer which is non-breathing that is so sealed that normally there is no significant interchange between its contents and the external atmosphere. No conservator is provided. Such a transformer may or may not have a cushion of dry air (or inert gas for example; Nitrogen, IS 1747).

Two Categories of SEALED TRANSFORMERS

- a) Transformers in which the total volume of oil together with air (or inert gas) or any combination thereof, remains constant over the temperature range.

b.) Transformers in which the total volume of oil, air (or inert gas) or any combination thereof, varies over the temperature range and this variation is accommodated by a sealed flexible container (corrugated tank) or a flexible membrane.

- Sealed type transformers usually have a bolted / clamped / welded cover construction.

STANDARD RATINGS

(Clause **6.1**)

Nominal System Voltage	**Standard Ratings (kVA)**
Up to and including 11 kV -	6.3*,10*,16, 20*,25, 40*,63, 100, 160 , 200
Above 11 kV up to and including 22 kV-	63, 100, 160 and 200
Above 22 kV up to and including 33 kV -	100, 160 and 200

- NOTE -* ratings are non-preferred

NO LOAD VOLTAGE RATIOS

- The no-load voltage ratios shall be as follows:

3 300/433-250, 6 600/433-250, 11 000/433-250, 22 000/433-250 and 33 000/433-250 V

NOTE- Secondary voltage may be selected as 415-240 V, subject to agreement between User and Supplier

MAXIMUM TOTAL LOSSES & IMPEDANCE VALUES upto 11 kV class transformers

S.No	Rating (kVA)	Impedance (percent)	Max. Total Loss (W)					
			Energy Efficiency Level 1		Energy Efficiency Level 2		Energy Efficiency Level 3	
			50 % Load	100 % Load	50 % Load	100 % Load	50 % Load	100 % Load
i	6.3	4	53	245	48	225	42	205
ii	10	4.5	72	270	65	240	58	215
iii	16	4.5	150	480	135	440	120	400
iv	25	4.5	210	695	190	635	175	595
v	63	4.5	380	1250	340	1140	300	1050
vi	100	4.5	520	1800	475	1650	435	1500
vii	160	4.5	770	2200	670	1950	570	1700
viii	200	4.5	890	2700	780	2300	670	2100

LOSSES & IMPEDANCE VALUES above 11 kV and 22 kV class Transformers

* For transformers having voltage class above 11kV and up to and including 22 kV, the permissible total loss values shall not exceed by 5 percent of the maximum total loss values mentioned in above table.

- For transformers having voltage class above 22 kV and up to and including 33 kV, the permissible total loss values shall not exceed by 7 ½ percent of the maximum total loss values mentioned in above table
- The recommended impedance at 75°C for different ratings is as per above Table

Limits Of Temperature Rise

- The type of cooling shall be type ONAN as per IS
- 2026 (Part 2).

- The permissible temperature-rise shall not exceed the limits of 40°C (when measured by resistance method) for transformer winding and 35°C (measured by thermometer) for top oil when tested in accordance with IS 2026 (Part 2).

Three Phase Distribution Transformers Higher than 200kVA upto and including 2500 kVA

- Standard Ratings-
- Up to and including 11 kV - 250, 315, 400, 500, 630, 800,1000, 1250, 1600, 2000 and 2500 .
- Above 11 kV up to and including 22 kV - 250, 315, 400, 500, 630, 800,1000, 1250, 1600, 2000 and 2500
- Above 22 kV up to and including 33 kV - 250, 315, 400, 500, 630,800, 1000, 1250, 1600, 2000 and 2500

Nominal System Voltage

- Nominal system voltage shall be chosen from the following :

- HV - 3.3, 6.6, 11, 22 & 33 kV
- LV - 415V

Single Phase Distribution Transformers

upto and incl. 100 kVA sealed type.

- **Standard Ratings**:

Input Voltage	kVA Rating
11 kV	5,10,16 25,50*,75*,100*
22 kV	10,16 , 25 ,50*,75*,100*
33 kV	16 , 25 ,50*,75*,100*

* Non Preferred rating

Nominal System Voltages

- Nominal system voltage shall be chosen from the following :

HV	11, 22 and 33 kV
LV	415V (240 V, 1 Phase)

Standard Materials

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

- Cold Rolled Grain Oriented electrical steel – IS 3024
- Amorphous core material – (IS under preparation)
- Copper/Aluminum conductor – IS 191, IS 1897,IS 7404,IS 12444,IS 13730/IS 6162 series as given in Annex A.
- Kraft paper –IS 9335 series as given in Annex A.
- Press Board – IS 1576
- Mineral oil – IS 335 (Note: use of other insulating liquids namely natural ester, synthetic organic ester -IS 16081 subject to agreement between User and Supplier)

Tests

- Routine Tests (to be conducted on all units)

The following shall constitute the routine tests:

- Measurement of winding resistance (IS 2026 Part 1)
- Measurement of voltage ratio and check of phase displacement (IS 2026 Part 1)
- Measurement of short-circuit impedance (principal tapping, when applicable) and load loss at 50% and 100% load (IS 2026 Part 1)
- Measurement of no-load loss and current (IS 2026 Part 1)
- Measurement of insulation resistance (IS 2026 Part 1)
- Induced over-voltage withstand test (IS 2026 Part 3)
- Separate-source voltage withstand test (IS 2026 Part 3)
- Pressure test } Additional Tests
- }
- Oil leakage test }

Contd...

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- **Type Tests:** to be conducted on one unit
- The following shall constitute the type tests:

- Lightning impulse test (IS 2026: Part 3)

- Temperature-rise test (IS 2026: Part 2)

- NOTE - Maximum measured total loss (No load at rated excitation + load loss at maximum current tap converted to 75 °C reference temperature) at 100 percent loading shall be supplied during temperature rise test.

- 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)

- Pressure test (see 21.5)

Contd.

- **Special Tests: (to be conducted on one unit)**

The following shall constitute the special tests which shall be carried out by mutual agreement between the User and Supplier.

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% voltage (see 5.9.3)

d) Paint adhesion test

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

Method of Declaring Efficiency

- **EFFICIENCY**
-
- **B-1.1** The efficiency to be declared is the ratio of the output in kW to the input in kW and calculated as under.
-
- Efficiency = output/input = input- total losses/ 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.

SPECIAL 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.

The Gazette of India Extraordinary,

New Delhi, July 21, 2014

IS 1180(Part1):2014

- Date of Establishment : 19 July 2014

- Date of Cancellation of IS 1180 (Part 1): 1989 & IS 1180 (Part 2) : 1989 : 30 Jan 2015

SCHEDULE

[See paragraph 2(f)]

List of Electrical Transformers under mandatory Bureau of Indian Standards certification

Sl. No.	Indian Standard number (Latest version)	Title	ITC (HS) Code
		Outdoor type oil immersed Distribution Transformers upto and including 2500 KVA, 33KV- specification Part 1 Mineral oil immersed	
1.	IS 1180(Part 1):2014	(a) Three-phase ratings upto and including 200 KVA both Non-sealed type and sealed type. (b) Three phase ratings higher than 200 KVA upto and including 2500 KVA both non-sealed type and sealed type. (c) Single phase ratings upto and including 25 KVA sealed type.	85043100 85043200 85043300 85043400)

[F.No.5(2)/2009-PE.XI (Vol.II)]

AMBUJ SHARMA, Addl. Secy.

SCHEDULE

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Certification Activities

- Product certification
- Quality management system certification
- HACCP
- Food safety management system
- Occupational Health & Safety Managements Systems certification
- Environmental management system certification
- Hallmarking of gold jewellery
- Certification schemes for foreign manufacturers and Indian importers

Certification Activities of BIS

Product Certification

- Scheme for Indian Manufacturers
- Foreign Manufacturers Scheme
- Indian Importers Scheme
- Hallmarking of Gold and Silver Jewellery

Management Systems Certification

- Quality Management System (IS/ISO 9001)
- Environmental Management Systems (IS/ISO 14001)
- Occupational Health and Safety Management Systems (IS18001)
- Hazard Analysis and Critical Control Points (HACCP) (IS 15000 – CODEX based)
- Service Quality Management System (IS 15700)
- Information Security Management System (IS/ISO 27000)
- Food Safety Management System (IS/ISO 22000)

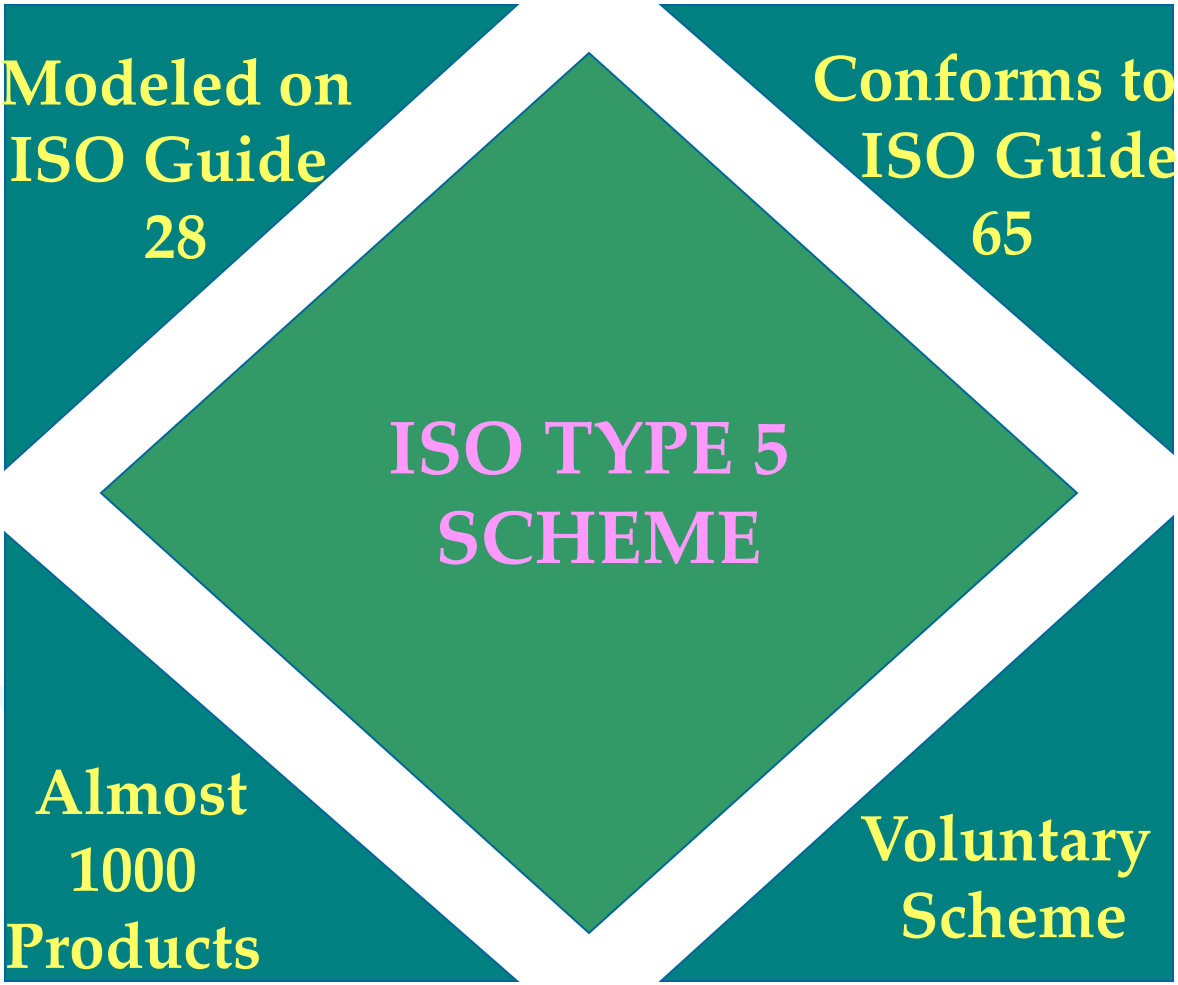
CERTIFICATION ACTIVITIES OF BIS (CONTD.)

Supported by:

- Testing Laboratories

- BIS Labs
- Other Labs
- Accreditation under National Laboratory Accreditation Scheme according to ISO/IEC 17025 by NABL
- Traceability to APLAC/ILAC for International recognition of Test Reports

PRODUCT CERTIFICATION



TYPE 5 SCHEME

Type testing and assessment of factory quality control and its acceptance followed by surveillance that takes into account audit of factory quality control and testing of samples both from factory and open market

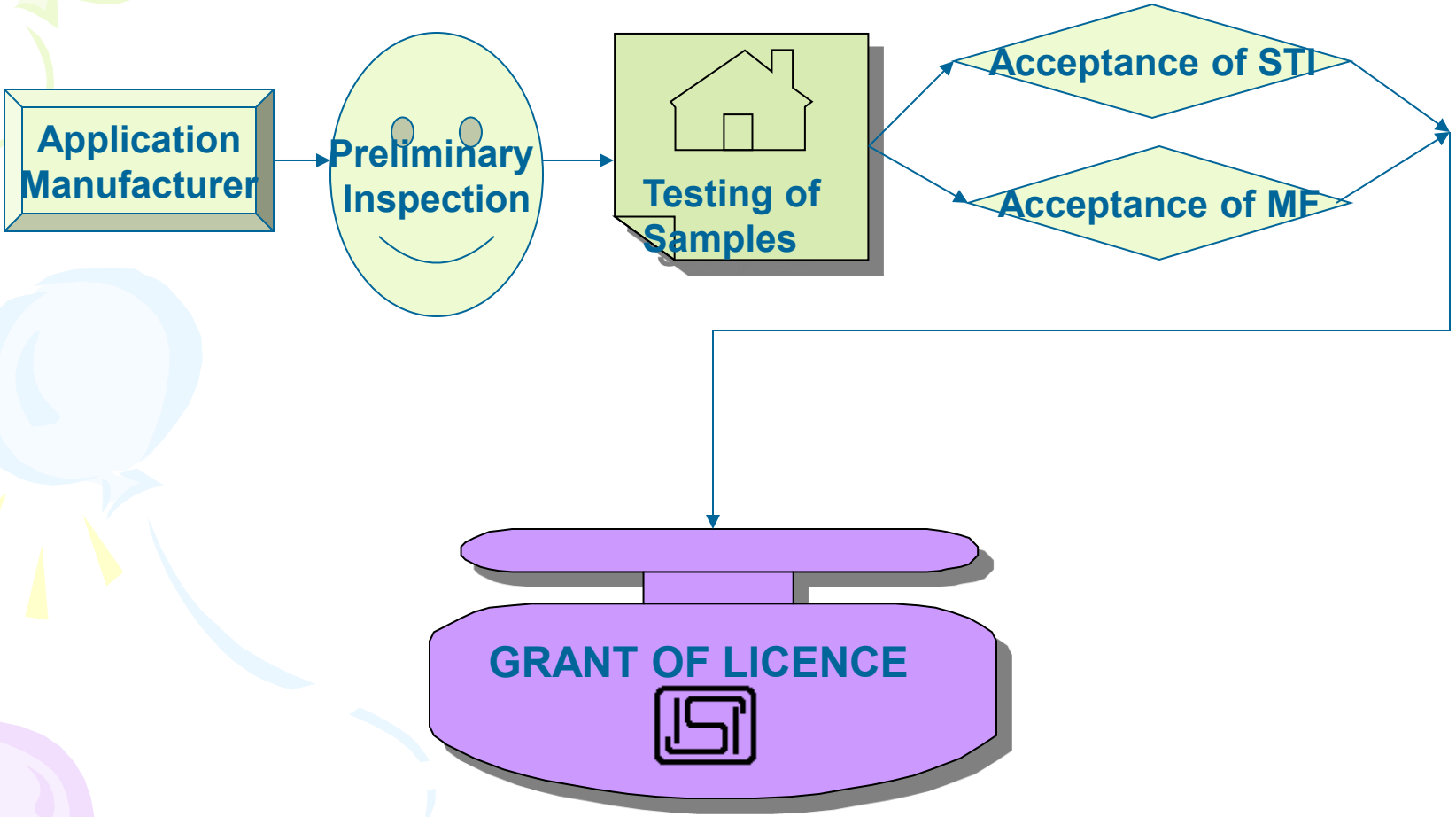
Product Certification

- Started in 1955 under ISI Certification Marks Act, 1952
- Offers third party assurance, based on well defined scheme of testing and inspection and ensuring adequacy of in-process quality control.
- Basically voluntary in nature.
  - Few products however covered under mandatory certification due to reasons of human health and safety.
- Operated through a network of 5 Regional, 33Branch and 5 Inspection Offices throughout India with Headquarters at New Delhi.

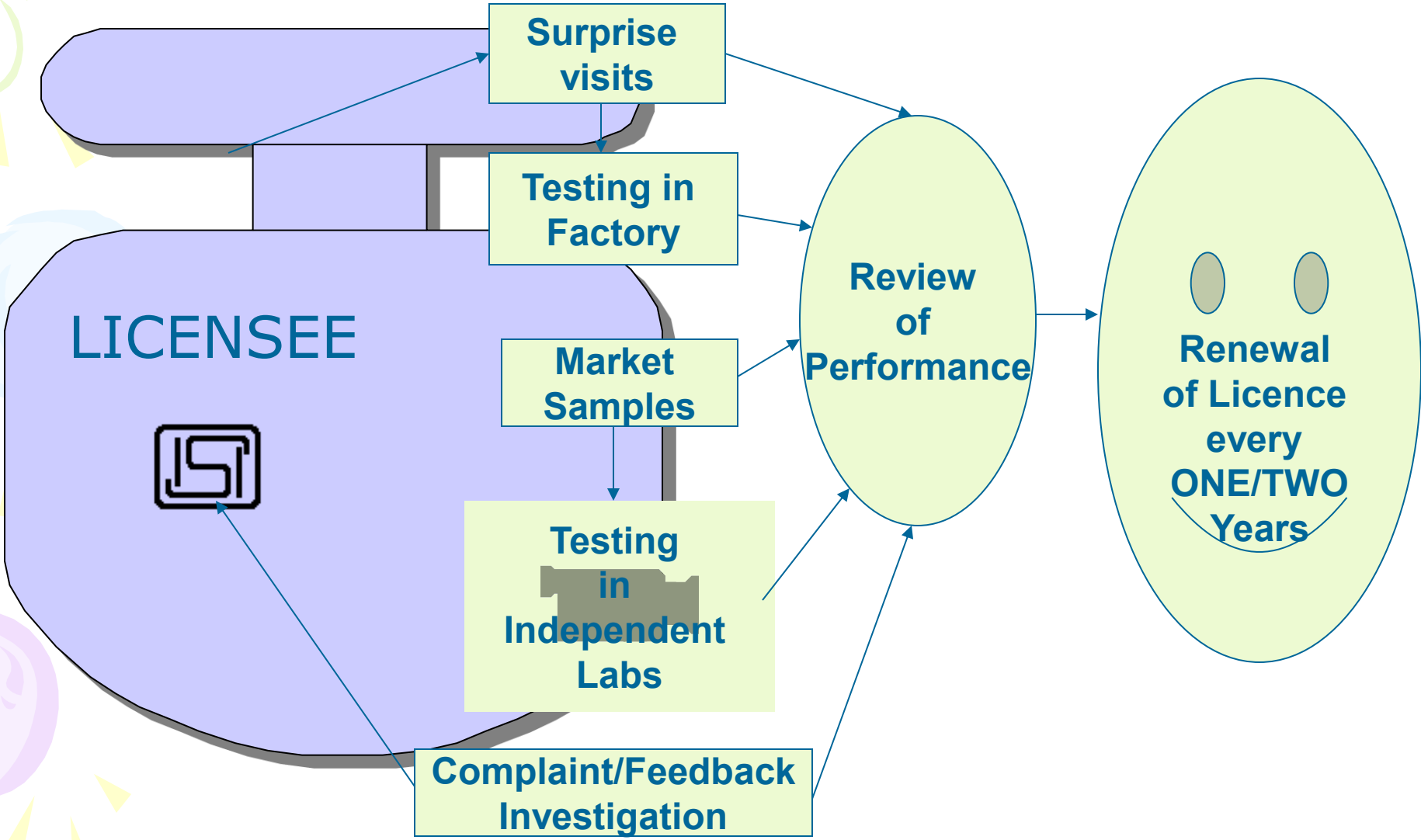
CERTIFICATION PROCEDURE

- APPLICATION
- PRELIMINARY INSPECTION
- TESTING OF SAMPLES
- ACCEPTANCE OF SCHEME OF TESTING & INSPECTION
- ACCEPTANCE OF MARKING FEE
- GRANT OF LICENCE
- MONITORING/ SURVEILLANCE
  - SURPRISE VISITS
  - TESTING IN FACTORY
  - TESTING IN INDEPENDENT LABORATORIES
  - FACTORY SAMPLES
  - MARKET SAMPLES
- FEEDBACK FROM ORGANIZED CONSUMERS
- INVESTIGATION OF COMPLAINTS
- RENEWAL OF LICENCE EVERY ONE/ TWO YEARS

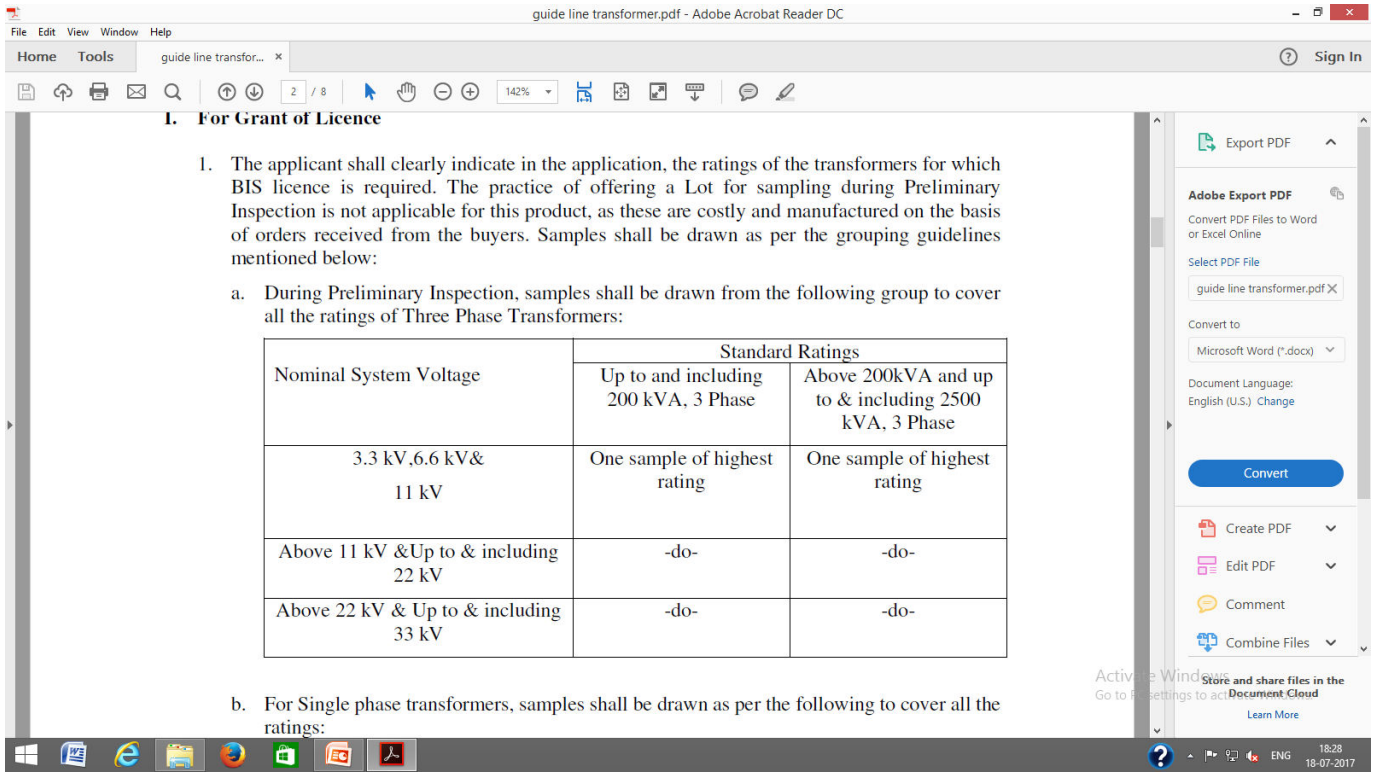
CERTIFICATION PROCESS - NORMAL PROCEDURE
[A] GRANT OF LICENCE



CERTIFICATION PROCESS
[B] MONITORING/SURVEILLANCE



Guide Line for Certification of Transformer



b. For Single phase transformers, samples shall be drawn as per the following to cover all the ratings:

Nominal System Voltage	Standard Ratings
11kV	One sample of highest rating
22kV	-do-
33kV	-do-

c. For Sealed and Non-Sealed construction, separate samples are not required to be drawn for Independent testing. If sealed sample is already drawn, non-sealed variety can be included in the scope of the licence after its conformity to pressure test requirements as per IS 1180(Part 1): 2014 and vice-versa. This testing may be done in factory or independent testing. Inspection charges as applicable shall be collected for factory testing.

d. Separate sample of transformer is required for change in the core material (CRGO/Amorphous) and winding material (Aluminium/Copper).

e. Non preferred ratings within the group as mentioned in Table-1 of the ISS may be covered in the scope of the licence based on the declaration submitted by the manufacturer w.r.t

design calculations, maximum total losses and declared technical parameters as per Annex-1.

f. If transformers with higher energy efficiency level is drawn for testing and found passing, the scope of licence shall also cover transformers with lower energy efficiency levels, as specified in the ISS within the group.

g. During Preliminary Inspection, one sample of highest rating from each group, shall be selected to cover the entire range within the group for which licence has been applied for, as per the above mentioned table at 1(a) and (b). In case it is not possible to draw the highest rating within the group, then the scope of the licence shall be restricted to the range up to the rating of sample tested for a particular group. The relevant drawings of the samples of transformer along with technical parameters as per Annex 1, shall also be collected and sent to the laboratory with the sample.

h. The Independent test reports issued by the labs cover only routine, type and special tests as specified in clause 21 of IS 1180 (Part 1) : 2014.The general requirements as specified in the ISS under cl. 6.9/7.9/8.9, 11, 14, 15.3, 15.5, 16 and 20.1 are not covered. In order to ensure conformity to these general requirements, these shall be verified in the factory

product meets the said requirement. Whenever these requirements are verified in the factory and found to be non-conforming, samples shall not be drawn for IT. Corrective action must be taken & verified before sample drawal.

i. An undertaking from the applicant that the ratings/varieties, which are covered in the scope of the license without testing, by virtue of the grouping guidelines, will conform to the requirements of the ISS before applying the standard mark and that the firm at the first instance shall get the transformer tested at BIS recognized laboratories/Group-2 category of Laboratory for all parameters under Routine Tests and Type tests shall be obtained. Such test reports of conformity shall be produced to BIS for records.

   Note: These requirements shall be stated in the Grant of Licence letter.

j. All tests shall be carried out at BIS recognized/Group-2 category of laboratories. The licence shall be granted once the assessment during preliminary inspection is satisfactory, no action is pending and the product passes in the type tests and the routine tests in independent testing and general requirements in factory testing as indicated above.

k. Offering of two samples (one FS + one CS) by the applicant manufacturer during PI is desirable. However, if the firm expresses difficulty in offering two samples and only one sample is offered during PI, the same may be accepted. In case only one piece of the transformer is offered, tests as mentioned under the Routine tests of the above guidelines may be carried out on the sample during the PI. Then, the same sample may be sent for independent testing along with the technical parameters as per Annex 1 and the drawings. In case of any dispute/contradictions between the factory test results and the test results of

no action is pending and the product passes in the type tests and the routine tests in independent testing and general requirements in factory testing as indicated above.

k. Offering of two samples (one FS + one CS) by the applicant manufacturer during PI is desirable. However, if the firm expresses difficulty in offering two samples and only one sample is offered during PI, the same may be accepted. In case only one piece of the transformer is offered, tests as mentioned under the Routine tests of the above guidelines may be carried out on the sample during the PI. Then, the same sample may be sent for independent testing along with the technical parameters as per Annex 1 and the drawings. In case of any dispute/contradictions between the factory test results and the test results of the independent laboratory, root cause analysis shall be done and further course of action shall be based on results of such analysis. However, an undertaking may be obtained from the applicant firm in such cases that any decision of BIS shall be acceptable to the applicant in this regard.

l. The applicant is mandatorily required to have testing facilities in-house for all routine tests. In-house testing facilities for type tests i.e. 'Lightning Impulse Test', 'Short Circuit Test', 'Temperature Rise Test' &'Permissible Flux Density &Over-fluxing Test', are desirable. However, considering the facts of specialized nature of tests and costly testing equipment, testing facilities of BIS recognized laboratories may be availed by the applicant as per OMPC for type tests only.

1) Compliance of CRGO Electrical Steel as per IS 3024(Clause 9.1 a) which is under compulsory BIS certification shall be ensured through test certificate of BIS licensee.
2) Presently the Indian Standard for amorphous material is under preparation. In case of transformer with amorphous core, supplier's certificate & declaration from applicant regarding the material may be accepted till the time the standard is established.
3) Compliance of Copper/Aluminum conductor (Clause 9.1 c) shall be ensured through a Test Report/Certificate from BIS recognized/Group-2 category of laboratories.
   Refer 'Note' given below for any other situation.
4) Compliance of Kraft Paper (Cl. 9.1 d), Press Board (Cl. 9.1 e) and Gasket (Cl. 15.4) shall be ensured through a Test Certificate from a BIS recognized laboratory/Group-2 category of Laboratory.
   Refer 'Note' given below for any other situation.
5) Compliance of Transformer Oil (clause 9) as per IS 335 or any other insulating liquid permitted through the note under Cl. 9.1 shall be ensured through a Test Certificate from supplier of ISI Marked material or applicant firm getting the same tested from a BIS recognized lab. In the case of natural ester being used as insulating liquid supplier's certificate may be accepted.
   Refer 'Note' given below for any other situation.
6) Compliance of Bushings (clause 12) as per IS 2099/7421 & relevant part of IS 3347 shall be ensured through a Test Certificate from supplier or applicant firm getting the same tested from BIS recognized/Group-2 category of laboratories.
   Refer 'Note' given below for any other situation.

Note: Incase it is not possible to get a test report/certificate from BIS recognized Laboratory / Group-2 category of Laboratory for any or more of the above mentioned raw material(s), then only test report/certificate from any NABL accredited Government/Private Laboratory may be accepted. If there exists no possibility of getting test report from any of the above mentioned independent testing laboratory, test report/certificate from suppliers may be accepted in such a circumstance for ascertaining conformity.

Laboratory may be accepted. If there exists no possibility of getting test report from any of the above mentioned independent testing laboratory, test report/certificate from suppliers may be accepted in such a circumstance for ascertaining conformity.

2 **Scope of License:** The scope of the license shall clearly indicate the following-

a) Standard Rating in kVA
b) Nominal System Voltage in kV
c) Single/Three phase
d) Sealed/Non sealed
e) Aluminium/Copper wound
f) CRGO/Amorphous core
g) Energy Efficiency Level
h) Maximum Total Loss, in case of non-preferred ratings

Note: The GOL letter shall clearly mention the details regarding submission of independent test reports by the licensee on the first instance of manufacturing of a variety as mentioned at 1 i) above.

3 **For Operation of Licence**

a) The grouping guideline for sampling and testing of the product aims at assessing the manufacturer's capability. The ratings/varieties, which are covered in the scope of the license without testing, by virtue of the grouping guidelines, must conform to the requirements of the

b) During operation of licence, surveillance inspections shall be carried out as per the provisions of OMPC. During surveillance inspections, it shall be verified that, all those ratings/varieties which were covered in the scope of the licence as per the grouping guidelines (without testing), have been got tested for the routine and type test requirements as per IS 1180(Part 1):2014 from a BIS recognized laboratory on the first instance of production, as per the undertaking submitted while grant of licence. Sample shall be tested in factory for all Routine Tests. Sample shall be drawn for independent testing at BIS recognized laboratories/Group-2 category of Laboratory for all parameters under Routine Tests. For this purpose the licensee shall inform BIS about its production schedule in advance for timely planning of surveillance inspection. If during the periodic inspection stock is not found, licensee shall be advised to inform production schedule and the period in which inspection could be undertaken by BIS IO, at least two weeks in advance. If licensee doesn't offer sample for IT or test reports covering routine test from IT lab is not made available in-spite of our advice, it should be construed as non-compliance to STI and action as per OMPC shall be taken.

c) For Market Surveillance, as the product is heavy and difficult to transport, apart from being costly to purchase, feedback from the organised buyers (State Electricity Boards, Utilities, and DISCOMs etc.) may be obtained. In case the buyer has tested any such product in the factory of the manufacturer or at any independent laboratory, such test results may be obtained from them and treated as feedback on the BIS Standard Marked products.

d) Practice of offering a lot during periodic inspection is also not applicable in this case, if firm expresses difficulty in offering two samples and only one sample is offered during periodic inspection, the same may be accepted.

4. **Inclusion of New Varieties**: for inclusion of new rating of the transformer, licensee shall submit a complete test report indicating conformity of the product from BIS recognized laboratory, along with the certified drawings and design parameters. Verification of General requirements at factory is not required to be done for inclusion of varieties. Grouping of varieties to be covered shall be as per the grouping guidelines.

A1 | fx | List Of Major Machinery required for Manufacturing of Transformers as per IS 1180-1:2014

A	B	C	

List Of Major Machinery required for Manufacturing of Transformers as

Sl No.	Machine Name	Relevant Activity	Remarks
1	M/Cs for Cutting, Bending, Shearing of Mild Steel (MS) Material	Fabrication of Tanks	---
2	Manual / Hydraulic press /punch		---
3	Drilling M/C		---
4	Welding M/C with relevant tools		All welding operations shall be carried out by qualified welders (As per Cl 15.1.3 of IS 1180-1:2
5	Fin Folding/ Fin Welding M/C		Only for corrugation tanks
6	Sheet Rolling machine		Only for single phase round tanks
7	Shot Blasting booth / 7 Tank Process		for surface preperation (Mandatory)
8	Spray Paint / Powder Coating booth		---
9	Core Slitting M/C		Not applicable if core slits / loops are procured
10	Cut to length M/C (Stacked core)	Core Assembly	
11	Core Winding Line (Only for Amorphous)		Not applicable if core loops are procured
12	Core wrapping / Forming M/C (Wound core)		
13	C.A./BA Furnace		
14	L..V. Winding M/Cs	Winding & Core Coil assembly	---
15	H.V. Winding M/Cs		---
16	Heating Oven		---
17	Crimping & Brazing tools with Oxygen & Acytyline gas cylinders		Shall be operated by qualified brazers
18	Vacuum Chamber/Oven.	Tanking	---
19	Oil Degassing & filtering M/C		---
20	General tools (Spanners, Torque wrences, etc)	handling facilities for all operations (as applicable)	---
21	Fork lifts		---
22	Hoists / Cranes		---

C26 | steel tape and vernier

List of Test Equipment/Instruments required for conducting tests as

S. No.	Test parameter	Test Equipment/ instruments required	Remarks
Routine Tests (As per BIS Guidelines, the applicant is mandatorily required to have routine test facility)			
1	Cl 21.2 a).Measurement of Winding Resistance	Transformer Winding Resistance Meter	0.5 class or better
		Glass Thermometers / Temperature sensors	---
2	Cl 21.2. b) Measurement of Voltage Ratio and check Phase Displacement	Turns Ratio Meter	0.5 class or better
		Digital Clamp Meter / Multi meter	---
		Power source (UPS / Variac / MG Set)	---
3	Cl 21.2.c) Measurement of short-circuit impedance (principal tapping, when applicable) and load loss at 50 percent and 100 percent load	Digital Power Meter	0.2 class or better
		Power Source (MG Set / UPS) with constatnt 50 Hz supply	50 Hz supply is mandatory & r
	Cl 21.2.d) Measurement of no load loss and current	Voltage Transformers	---
	Cl 21.4.c) No load current at 112.5% percent Voltage	Current Transformers	---
		Glass Thermometers / Temperature sensors	---
4	Cl 21.2 e) Measurement of Insulation resistance	1 kV Insulation tester for ≤ 11 kV class & 5 kV Insulation tester for > 11 kV class	---
		Glass Thermometers / Temperature sensors	---
5	Cl 21.2.f) Induced over-voltage withstand test	MG Set. / Frequency Converter	0-100 or more Hz
		Stop Watch	---
6	Cl 21.2.g) Separate-source voltage withstand test	HV Test Set (In case least count is not 1 kv take separate hv	---
		Stop Watch	---
7	Cl.21.2.h) Pressure test	Pressure Gauges 0-100 Kpa L.c 1 Kpa	2 nos one for air pressure , c
		Air Compressor	---
		Steel rule / Measuring Tape	---
8	Cl.21.2.j) Oil Leakage test	Pressure Gauges 0-100Kpa L.c 1 Kpa	---
		Nitrogen Cylinders	---
9	cl 15.5 Coating thickness	Digital Coat meter 0-2000 micron l.c 1 micron	
10	clearance and creepage	steel tape and vernier	
Type / Special Tests			

C26 | steel tape and vernier

	A	B	C	
27	**Type / Special Tests**			
	(As per BIS Guidelines, the availability of test facility with applicant is optional; however, if required to be conducted at BI			
28	1	Cl.21.3.a) Lightning impulse test	Impulse generator	---
29			Potential Divider	---
30			Impulse Measuring System	---
31			Current Shunt	---
32	2	Cl.21.3 b) Temperature rise test	Digital Power Meter (or) set of voltmeters, Ammeters & Wattmeters	0.5 or better c
33			Power source (MG Set / UPS / Variac)	---
34			Intermediate Transformer	---
35			Voltage Transformers	---
36			Current Transformers	---
37			Glass Thermometers / Temperature sensors	---
38			Transformer Winding Resistance Meter	0.5 class or b
39			Stop Watch	---
40	3	Cl.21.3.c & 21.4.b) Short-Circuit withstand test	SC Generator / On-line sub-station	---
41			CB (Master Circuit Breaker & Make Switch) Panel	---
42			Sequence Controller & POW Closing Device	---
43			Current Measuring shunts / CTs	---
44			Oscilloscope / Waveform recorder	---
45			Inductance measuring set	0.2 class or b
46	4	Cl. 21.3.d) Pressure (type test)	Pressure &Vacuum gauges	---
47			Air Compressor	
48			Vacuum Pump	
49			Steel rule / Measuring Tape	
50	5	Cl.21.4.a) Determination of sound levels	Sound Level Meter	Class-1
51			Sound Level Calibrator	Class-1
52			Digital Power Meter	0.5 or better c
53			Power source (MG Set / UPS)	50 Hz supply
54	6	Cl. 21.4.d) Paint adhesion test	Cross Hatch Cutter	---
55	7	Cl.21.4 e) BDV and moisture content of oil	Oil BDV Test Set	0 to 80 kV (m
56			Colometer (Water content)	---

Note: As per Cl 4.0. of the STI, Testing instruments/equipments shall be carried out periodically from NABL accredited calibration laboratories where
Measurement System (NPL) to be ensured. All records of such calibrations to be kept.

Specific requirements tested only in factory during PI

Clause11 Clearance

Clause 14 The under-base of all three phase transformers upto 200kVA ratings shall be provided with two channelsof minimum size 75 mm × 40 mm as shown in Fig. 6 to make them suitable for fixing to a platform or plinth.'

The under-base of all transformers beyond 200 kVA may be as per Fig. 7 to make them suitable for mounting on rollers

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.

Clause15.3 All bolts/nuts/washers exposed to atmosphere shall be as follows:
a) Size 12 mm or below — stainless steel.
b) Above 12 mm — steel with suitable finish like electro galvanized with passivation or hot dip galvanized.

Clause 15.5 Inside of tank shall be painted with varnish or oil resistant paint. For external surfaces one coat of thermo setting powder paint or one coat of epoxy primer followed by two coats of polyurethane base paint shall be used. Table 12 shall be referred to for paint thickness for normal to medium corrosive atmosphere. For highly polluted atmosphere and special application external paint work shall be subject to agreement between the user and the transformer manufacturer.

Clause 16.1 Transformers of ratings 63 kVA and above with plain tank construction, the provision of conservator is mandatory. For sealed type transformers with or without inert gas cushion, conservator is not required.'

Clause 16.2 When a conservator is provided, oil gauge and the plain or dehydrating breathing device shall be fixed to the conservator which shall also be provided with a drain plug and a filling hole (1¼" normal size thread) with cover. The capacity of a conservator tank shall be designed keeping in view the total quantity of oil and its contraction and expansion due to temperature variations. In addition, the cover of main tank shall be provided with an air release plug to enable air trapped within to be released, unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank.

Clause **16.3** The inside diameter of the pipe connecting the conservator to the main tank should be 25 to 50 mm and it should be projected into the conservator so that its end is at least 20 mm above the bottom of the conservator so as to create a sump for collection of impurities. The minimum oil level corresponding to −5°C should be above the sump level.

'The following standard fittings shall be provided:

a) Two earthing terminals with the earthing symbol ⏚;

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).'

Formulas

HV Full load current = VA / (1.732xVolt)

LV Full load current = VA / (1.732xVolt)

HV Side I^2R losses = I^2R x1.5

LV Side I^2R losses = I^2R x0.5x3

Total I^2 R lossses @ Amb temp = Hv losses+ Lv losses

Total Stray losses @ Amb temp =Measured losses -I^2 R losses

I^2 R lossses @75° c temp = ((225+75) x losses) / (225+ Amb temp)

Stray losses @ 75° c temp=((225+Amb temp)(Stray losses at amb)) / 300

Total Full load losses at @75° c = I^2R losses at 75°c+Stray losses at 75°c

Total Impedance at ambient temp =(Imp voltage x1.732) / Full load current

Total Resistance at amb temp = I^2R losses / I^2

Total Reactance (X) =SQRT(Impedance ²- Resitance ²)

Resistance at@ 75° c =(300 x resistance at amb) /(225+Amb temp)

Impedance at 75° c =SQRT(R^2 at 75 + X^2)

Percentage Impedance =(Z at 75° c x I x 100)/V1

Percentage Resistance =(R 75° c x I x 100)/V1

Percentage Reactance =(X x I x 100) / V1

Regulation at Unity P.F =(%R cosø+%Xsinø) .

Regulation at 0.8 p.f.= (%R cosø+%Xsinø)+1/200(%R sinø-%Xcosø)2"

Efficiency at Unity P.F

At 125 % of Transformer Loading =(Kva x 1.25 x 100)/((kva x 1.25)+(I^2R losses x 1.25^2)+(No Load Losses))

Efficiency at 0.8 P.F

At 125 % of Transformer Loading =(Kva x 1.25xp.f x 100)/((kva xp.fx 1.25)+(I^2R losses x 1.25^2)+(No Load Losses))

THANK YOU