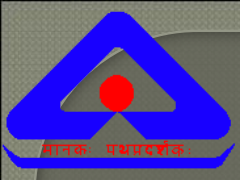


# PRESENTATION ON STANDARDS- DISTRIBUTION TRANSFORMERS



**BUREAU OF INDIAN STANDARDS  
BHOPAL**

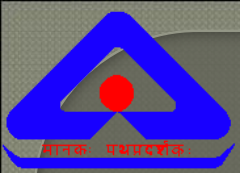


# Contents

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- BIS Act
- WTO Principle on Standard
- Process for development of Indian Standard
- Standards on Transformers
- Detailed provision of IS 1180-1
- Proposed Changes in IS 1180-1



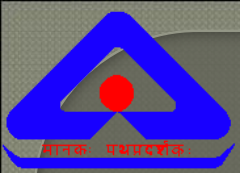


## BUREAU OF INDIAN STANDARDS

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- **National Standards Body constituted under the Act of Parliament (1986)**
- **New BIS Act 2016 has been notified**
- **Indian Standards developed by BIS through technical committee involving all concerned Stakeholders**
- **BIS standard development process in compliance with WTO-TBT principles**





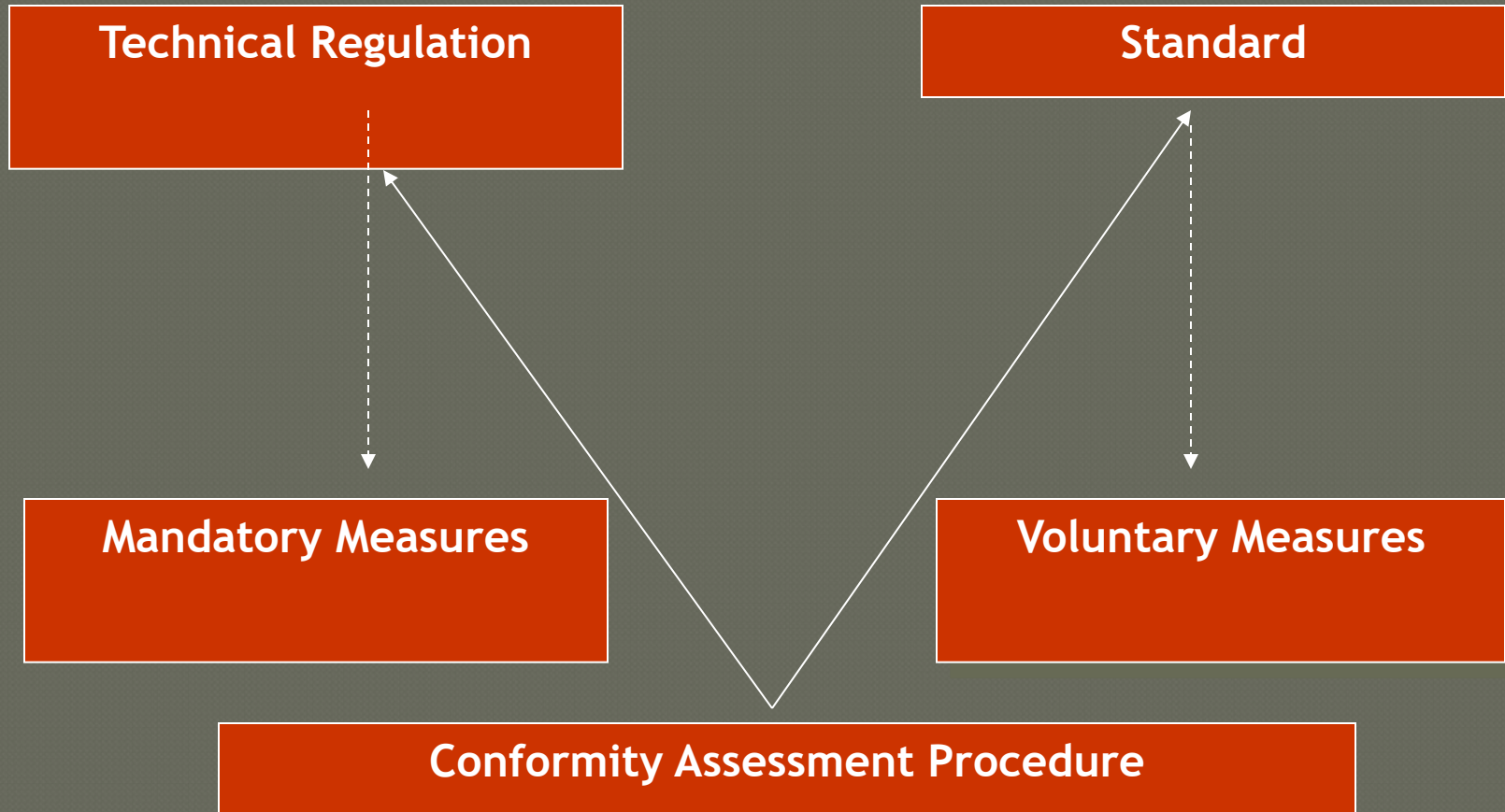
# **Technical Barriers to Trade (TBT)**

## **WTO Agreements**

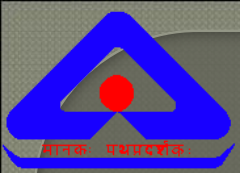
- Rules for international trade being written through various WTO Agreements
- Rules pertaining to Standards, Regulations and Conformity Assessment for Trade in Goods are laid down in:
  - **Agreement on Sanitary and Phyto Sanitary Measures (SPS)**
  - **Agreement on Technical Barriers to Trade (TBT)**



# What measures are subject to TBT provisions?







# WTO Principles on Standardization

- Transparency
- Openness
- Impartiality and consensus
- Effectiveness and relevance
- Coherence
- Development dimension
- Compliance of “Code of Good Practice for the Preparation, Adoption and Application of Standards”



# GOVERNANCE FRAMEWORK

DG + 9 members  
Ministry – 2  
Consumer – 1  
Industry/trade – 2  
Scientific/ research – 1  
Technical/ Educational – 1  
**Bureau members -2 :**  
Plus 9 Special invitees

Bureau

Standards  
Advisory  
Committee

Division  
Councils

Sectional Committees

Panel/ Sub-Committees

1

1

14

322

509

Minister in Charge  
Minister of State  
Secretary of MoCA  
Director General +  
Other members appointed by Govt from  
GoVt, Industry, Scientific & research  
Institutions and other interests

## Advisory Committee regulations 1987

1. Harmonious Development of Standards
2. Establishment Publication and promotion of Standards
3. Collaboration with SDO's of Country and Abroad
4. Formulation of guidelines for effective functioning of DC
5. Other Matters regarding Standardization

## Rule 7:

Consumers, regulatory and other Government bodies, industry, scientists, technologists and testing organizations. These may also include consultants.

An officer of the Bureau shall be the Member Secretary.

Experts involved approx 15000





# Bureau of Indian Standards (BIS)

## Areas of Standardization

Chemical

Civil  
Engineering

Electronics and  
Information  
Technology

Electro-technical

Food and  
Agriculture

Management  
and Systems

Mechanical  
Engineering

Medical  
Equipment and  
Hospital Planning

Metallurgical  
Engineering

Petrochemical,  
Coal & Related  
Products

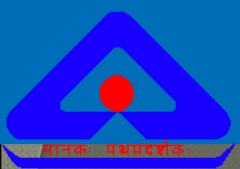
Production and  
General  
Engineering

Textiles

Transport  
Engineering

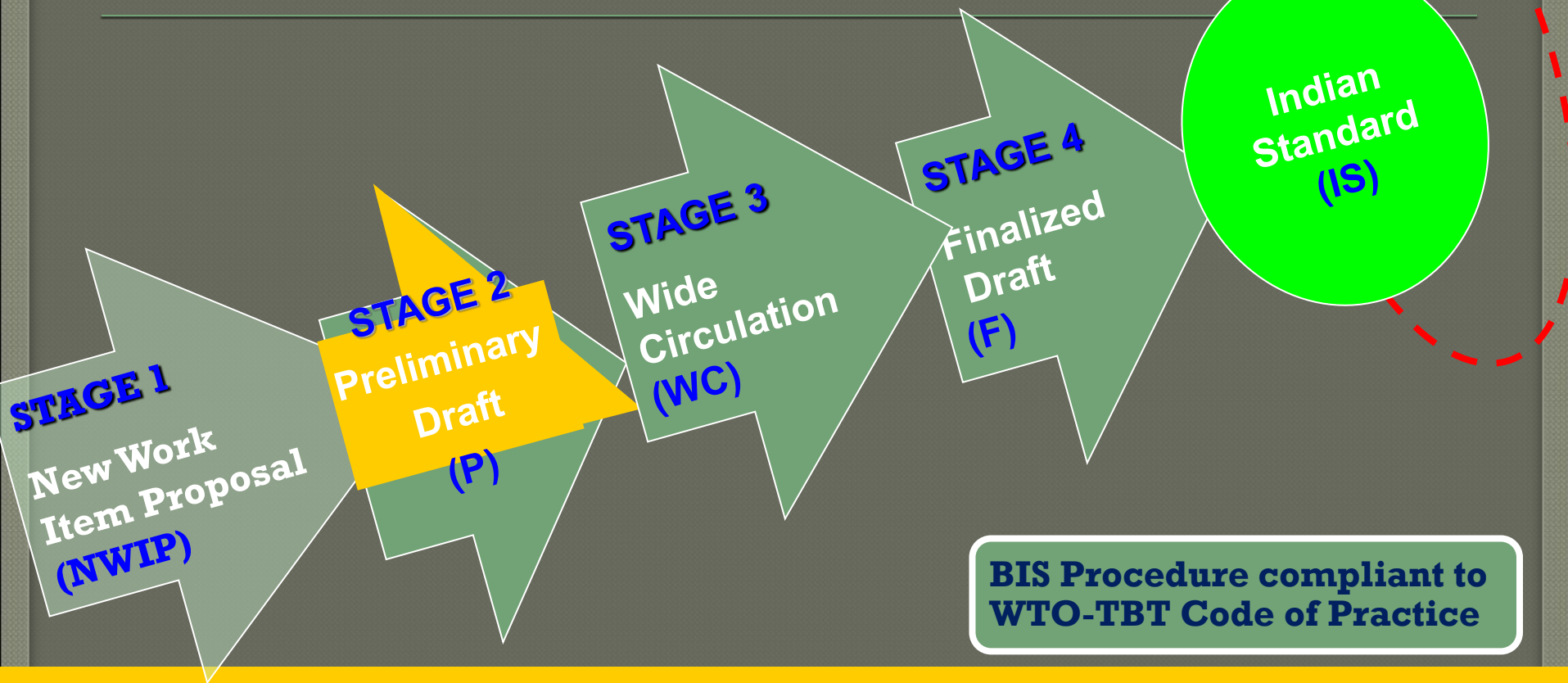
Water  
Resources





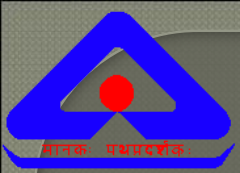
# Bureau of Indian Standards (BIS)

## Stages of Standards Formulation



Stage 2 : Building consensus among committee members

Stage 3: Building national consensus

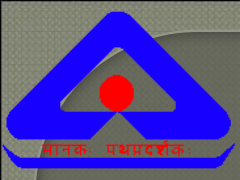


# Time norms for standard development

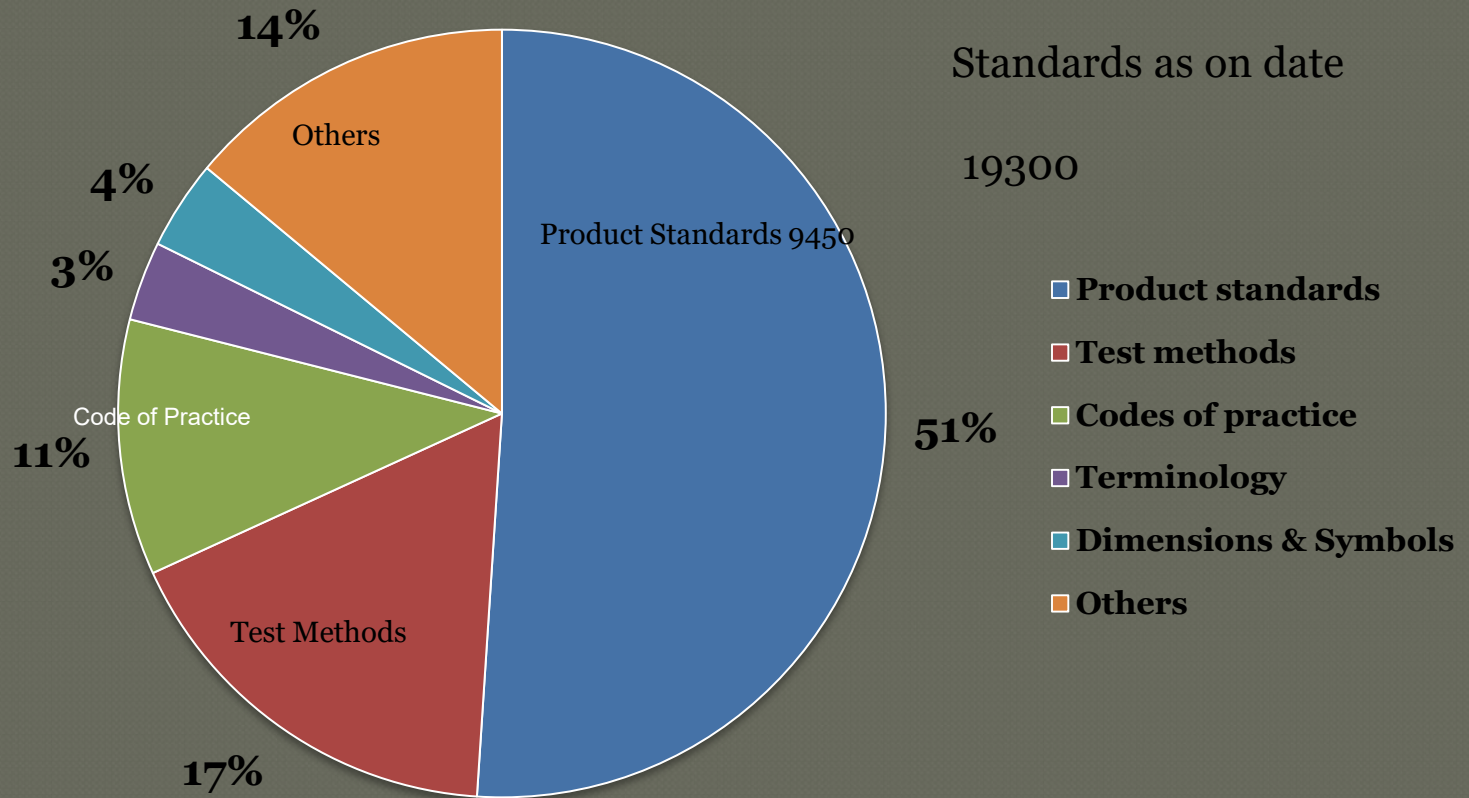
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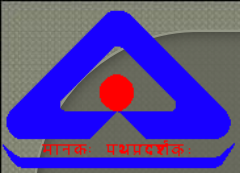
- Priority I 12 Months
- Priority II 24 Months



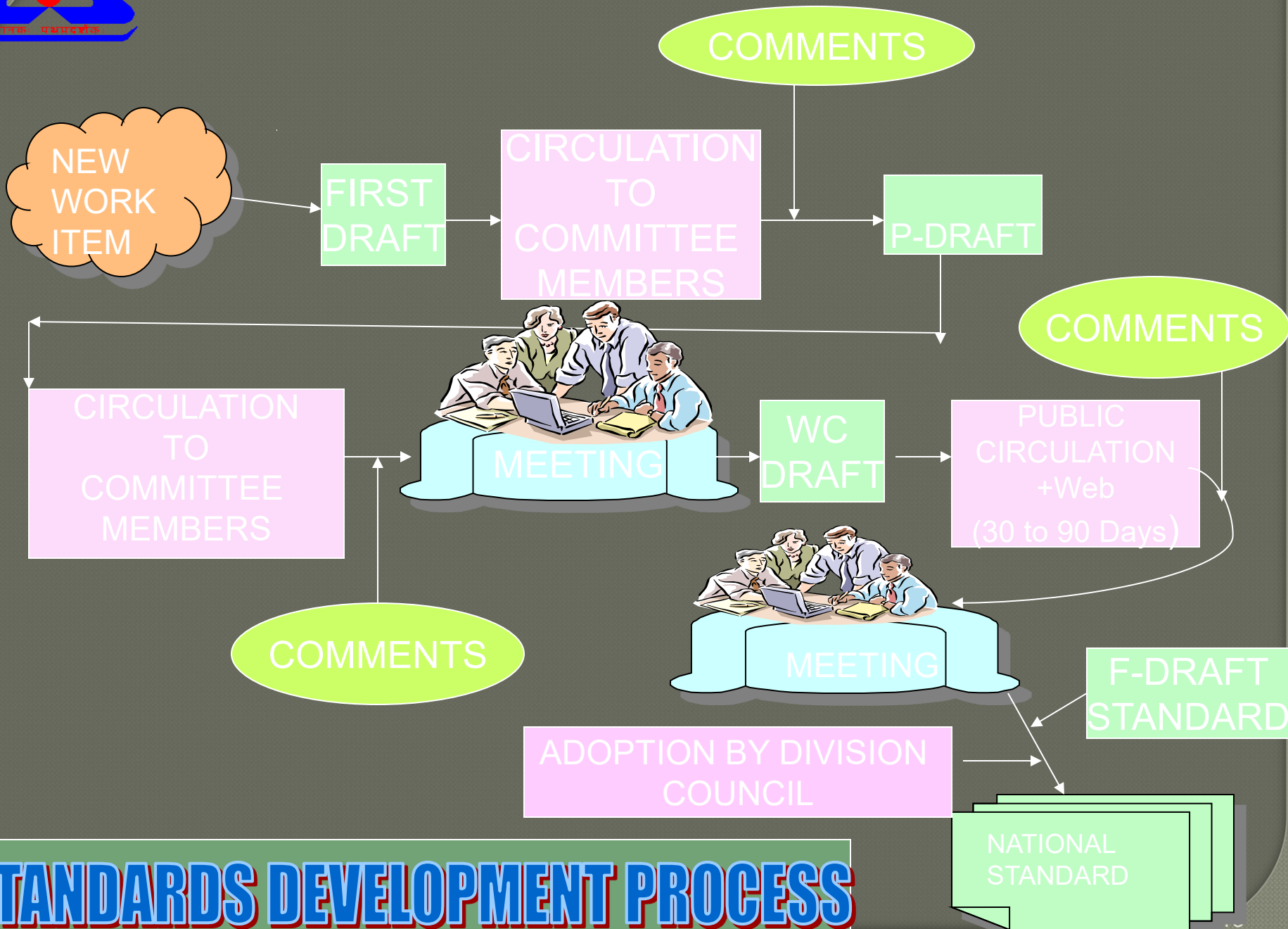
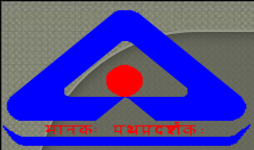


# Distribution of Standards

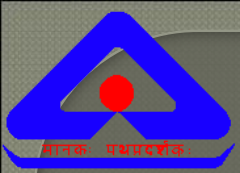








# STANDARDS DEVELOPMENT PROCESS



# Technical committee on **TRANSFORMERS**

- ETD 16 – Transformers
  - 40 Standards published
  - Power Transformer
  - Distribution Transformer
  - Dry type transformer
  - Accessories/Fittings
  - Reactors
  - Voltage Corrector
  - Tap Changer
  - Code for selection, installation and maintenance





# 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.



## NEED AND OBJECTIVE FOR REVISION

- The main objective in formulation of IS1180 Part 1 was to bring uniformity in technical specifications of DTs by various stakeholders in power industry.
- IS1180 is a National Standard formulated by BIS, taking into account needs of Stakeholders and various guidelines issued by Ministry of Power, Ministry of Heavy Industries, Ministry of Commerce, CEA, REC, BEE and various Electricity Boards/Discoms.
- All the stakeholders need to respect the standard in toto unless there is a serious objection which is impractical to achieve or implement.





# REVISED VERSION OF IS ON DISTRIBUTION TRANSFORMERS

- **IS 1180(Part 1)** - Outdoor type, insulated liquid immersed Distribution Transformers up to and including 2500 kVA, 33kV (Part 1: Mineral Oil Immersed)
- Published in 2014



# SALIENT FEATURES OF IS 1180(Part 1): 2014

## ❖ SCOPE

Includes Outdoor 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 25 kVA (sealed type)

### *Proposed Amendment No. 1*

- To include indoor type 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

- As per definition, DTs are meant for stepping down voltage used in distribution lines to the levels used by the customers
- Transformer with Primary voltage of 3.3, 6.6, 11, 22 or 33 kV and secondary voltage of 433 Volt, 3 Phase (250 volt for single phase ) are called Distribution Transformers.

## Proposed Amendment No. 1

- Amended definition of **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.'



# LIST OF STANDARDS NOT COVERED

To clarify and for ease in implementation, following exclusion list is being added through Amendment No. 1:

- 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;
- i) Mining transformers;
- j) Transformers for solar, wind power application;
- k) Transformers for railways (locomotive and other applications);
- l) Furnace transformers;
- m) Rectifier transformers; and
- n) Dual ratio in primary/secondary windings transformers





# RATING

Given in Tables 1, 4, 7:

- Preferred
- Non-preferred (Maximum total losses are subject to agreement between the user and the supplier)

## *Proposed Amendment No. 1*

- Following ratings are being added through amendment no. 1:
  - a) **Preferred rating:** 800 kVA (3 phase, upto 33 kV)
  - b) **Non preferred ratings:** 50 kVA, 75 kVA, 100 kVA (single phase, 11 kV, 22 kV, 33 kV)



# BASIC INSULATION LEVEL

- Rated BIL values for Nominal System Voltages are given in Table 2, Table 5 and Table 8.

## *Propose Amendment No. 1*

- The BIL values as **minimum** values. However, insulation coordination of all relevant fitting corresponding to higher BIL may be ensured.





# TAPPINGS

➤ No taps are generally required upto 100 kVA, unless specified

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 greater than 500 kVA, 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		

## *Proposed Amendment no. 1*

➤ It has been decided to make the provision of Tappings (both range and steps) subject to agreement between the user and the supplier for which amendment is being issued.



# 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
- No load losses are dependent on so many factors including design, therefore not given separately

## *Proposed Amendment no. 1*

- Losses for non-preferred ratings have been added through amendment which is being issued.





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

<b>Voltage class</b>	<b>Maximum total losses for 3 phase transformers upto and including 200 kVA</b>	<b>Maximum total losses for 3 phase transformers higher than 200 kVA and upto and including 2500 kVA</b>	<b>Maximum total losses for single phase transformers upto and including 25 kVA</b>
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



# NO LOAD CURRENT AND FLUX DENSITY

- Maximum Flux density variation shall not exceed 1.9 Tesla with voltage and frequency variation  
(Design calculation to be submitted)
- No load current shall not exceed 2 % (3% for 1 Ph) of full load current

**No Amendment proposal**





## % IMPEDENCE VALUES

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

**No Amendment proposal**



# MARKING PLATE DIMENSIONS

## MARKING:

### *Proposed Amendment No. 1*

Dimensions of Rating Plate, Terminal Marking Plate and Combined Rating and Terminal Plate have been made subject to agreement between the user and the supplier



# LIMITS OF TEMPERATURE RISE

➤ Limits are given as below:

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

No Amendment proposal





# LIMITS OF TEPEPERATURE RISE

- These are **maximum limits of temperature rise**
- These limits in IS 1180 (Part 1) : 2014 are more stringent compared to International standards
- Lower temperature rise limits are acceptable but it might increase the cooling equipment cost

**No Amendment proposal**



## TERMINAL ARRANGEMENTS

❑ For Cable box, following provisions have been added through amendment:

- bus duct arrangement may be provided on low voltage side by agreement between the user and the supplier
- Porcelain/ Epoxy/Silicon Rubber Bushing may also be used subject to agreement between the user and the supplier.'

❑ For bushings, following notes has been added through amendment:

- For heavily polluted atmosphere, dimensions of bushings shall confirm to IS 8603.
- Cast resin or polymer bushing can also be used with performance requirements as per IS 2099 and IS 7421

❑ LV Bushing Voltage Class:

It has been decided to change LV Bushing Voltage Class from 1.1 kV to 1 kV



# MINIMUM CLEARANCES IN AIR

- Specified clearances values are MINIMUM values
- Clearances above these values are acceptable as per IS 1180 (Part 1) : 2014
- Clearances between coils and no. of coils are not given as these are design parameters

**No Amendment proposal**





# MOUNTING ARRANGEMENT

- Mounting arrangement is given in cl 14
- Bidirectional rollers can also be used as per mutual agreement between the user and the supplier

## *Proposed Amendment no. 1*

### 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

- Preferred mounting dimensions given under table in Fig 7 have been modified
- Note added under Fig. 7 – Any other mounting dimensions are subject to agreement between the user and the supplier



# PAINT THICKNESS

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

**No Amendment proposal**

# CONSTRUCTION REQUIREMENTS FOR TRANSFORMER TANK

## *Proposed Amendment No. 1*

- **Given under clause 15**
- Minimum thickness at the corrugations has been specified as 1.0 mm through amendment



## CHANGES IN STANDARD FITTINGS given under clause 20.1

Existing standard fitting	Changes to be made through amendment
Two earthing terminals with the earthing symbol =  ;	No change
Oil level gauge indicating oil level at minimum, 30°C and maximum operating temperature; NOTES <b>1 Minimum and maximum positions correspond to the</b> operating temperature of –5°C and 90°C respectively (for non-sealed type transformer). <b>2 Minimum position corresponds to the operating</b> temperature of 30°C (for sealed type transformers).	Oil level gauge indicating oil level at minimum, 30°C and maximum operating temperature; NOTES <b>1</b> Minimum and maximum positions correspond to the operating temperature of –5°C and 90°C respectively (for non-sealed type transformer). <b>2</b> Only minimum position corresponding to the operating temperature of 30°C (for sealed type transformers).
Air release device (for non-sealed type transformers)	No change
Rating and terminal marking plates;	No change
Plain breathing device for non-sealed type transformers which would not permit ingress of rain water and insects up to 200 kVA transformers. Above 200 kVA transformers dehydrating breather shall be provided	Dehydrating breather shall be provided for non-sealed type transformers;
Drain-cum-sampling valve ( $\frac{3}{4}$ " nominal size thread, IS 554) preferably steel with plug for three phase transformers;	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.

Existing standard fitting	Changes to be made through amendment
Thermometer pocket with cap;	No Change
Oil filling holes having (1¼" nominal size thread) with cover (for sealed type transformers without conservator)	Oil/Nitrogen/Air filling hole having (1¼" nominal size thread) with cover (for sealed type transformers without conservator);
An extended pipe connection on upper end with welded cover for sealed type transformers. The pipe should be suitably threaded over a sufficient length to enable use of a refilling/siphon connection after removing the welded cover or any other similar arrangement capable of reuse;	Deleted
Lifting lugs for the complete transformer as well as for core and winding assembly;	No Change
Nitrogen/air filling device/pipe with welded cover capable of reuse (for sealed type transformer);	Deleted
Pressure relief device or explosion vent above 200 kVA;	Pressure relief device or explosion vent [for sealed type transformers (for all ratings) and non-sealed type transformers (for ratings above 200 kVA)];
One filter valve on the upper side of the tank (for transformers above 200 kVA);	No Change
Unidirectional flat rollers (for transformers above 200 kVA)	Deleted
Inspection hole (for transformers above 200 kVA);	Deleted
Pressure gauge for sealed transformers with radiators and nitrogen cushion (above 200 kVA);	Deleted
HV side neutral grounding strip (where one of the HV bushing terminal is connected to earth);	No Change
LV earthing arrangement for single phase transformers;	No Change
Buchholz relay for transformers above 1 000 kVA.	No Change
New fittings added	Arcing horns for HT side (one number per phase)

## CHANGES IN OPTIONAL FITTINGS given under clause 20.2:

Existing Optional fittings	Changes
Filter valve (1¼" nominal size thread) for transformers up to 200 kVA;	Filter valve for transformers up to 200 kVA;  NOTE — Valve size shall be as per agreement between the user and the supplier.'
Arcing horns or suitable rating lightning arrestors for HT side – 3 Nos. for transformers up to 200 kVA;	'c) Suitable rating lightning arrestors for HT side (one number per phase);'
Pressure relief device or explosion vent (up to 200 kVA)	Pressure relief device or explosion vent (upto 200 kVA for non-sealed type transformers);
Protection relay for sealed type transformers for internal parameters that is pressure, temperature, oil level and gas detection (above 1 000 kVA)	Protection relay for sealed type transformers for internal parameters that is pressure, temperature, oil level and gas detection
New Fittings	<p>'q) Unidirectional flat rollers (for transformers above 200 kVA);</p> <p>r) Drain-<i>cum</i>-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.</p> <p>s) Self protection/disconnection devices subject to agreement between the user and the supplier:</p> <ol style="list-style-type: none"> <li>1) Thermo-magnetic circuit breaker as self protection device on secondary side as per IS/IEC 60947-2 : 2003; and</li> <li>2)Expulsion fuse as disconnection device on primary side as per IS 9385 (Part 2): 1980.</li> </ol> <p>NOTE— Additional requirements for transformers with self protection/disconnection devices are under preparation.'</p>



## Proposed Amendment No. 1 -CHANGES IN TEST REQUIREMENTS

### a) ROUTINE TESTS

- **Separate-source voltage withstand test:** Following note has been added under this test:

‘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).’

### b) TYPE TESTS

- **Temperature-rise test:** Note given under this test was deleted.

#### ➤ **Pressure test**

##### a) Upto 200 kVA:

- Test requirements for corrugated tanks added
- Limits of deflection of flat plates from 1251 mm to 1750 mm has been added
- Note added that permanent deflection is not applicable for corrugations

## *Proposed Amendment No. 1*

### **b) Beyond 200 kVA**

- Test requirements for corrugated tanks added
- Note added that permanent deflection is not applicable for corrugations

### **➤ Leakage test**

Annexure providing additional information on Leakage test has been added.

### **❖ SPECIAL TESTS**

- These are to be conducted on one unit and shall be subject to agreement between user and supplier
- Paint adhesion test and BDV and moisture content on oil in the transformer may be carried out on more than one unit subject to agreement between user and the 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.



# THANK YOU