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|---|---|---|---|
| **Laboratory** | **Testing Laboratories (Units: 03, 04, 09, 10, 11 & 15), Toshiba Transmission & Distribution Systems (India) Private Limited, Rudraram Village, Patancheru Mandal, Medak, Telangana** | | |
| **Accreditation Standard** | **ISO/IEC 17025: 2005** | | |
| **Discipline** | **Electrical Testing** | **Issue Date** | **06.09.2016** |
| **Certificate Number** | **T-3002** | **Valid Until** | **05.09.2018** |
| **Last Amended on** | **-** | **Page** | **1 of 15** |

| S. No. | Product / Material of Test | Specific Test Performed | Test Method Specification against which tests are performed | Range of Testing / Limits of Detection |
|---|---|---|---|---|
| | | **AT LABORATORY** | | |
| **I.** | **TRANSFORMERS AND REACTORS** | | | |
| **1.** | **Power & Distribution Transformers Single And Three Phase Transformers Single Phase Oil Filled Transformers (5 kVA to 3333 kVA, 36 kV) Three Phase Oil Filled Transformers (6.3 kVA to 20000 kVA, 36 kV) Dry Type Transformers (25 kVA to 8000 kVA, 36 kV)** | Insulation Resistance | IS 2026-1: (2011)<br>IEC 60076-1: (2011)<br>IS 11171: (1985)<br>CEI EN 60076-1: (2015)<br>IEEE C.57.12.90: (2010) | 0.1 MΩ to 1 TΩ<br>(At 500 V, 1 kV, 2.5 kV, 5 kV) |
| | | Polarization Index And Absorption Index | CBIP Manual on Transformers: 2013, Section BB, Clause 3.5 | 0.1 MΩ to 1 TΩ<br>(At 500 V, 1 kV,2.5 kV, 5 kV) |
| | | Voltage Ratio And Check of Phase Displacement | IS 2026-1: (2011)<br>IS 11171: (1985)<br>IEC 60076-1: (2011)<br>IEC 60076-11: (2004)<br>CEI EN 60076-1: (2015)<br>IEEE C.57.12.90: (2010) | Qualitative<br>(Ratio 1 to Ratio 150) |
| | | Polarity<br>(For 1 Phase Only) | IS 2026-1: (2011)<br>IS 11171: (1985)<br>IEC 60076-1: (2011)<br>CEI EN 60076-1: (2015)<br>IEC 60076-11: (2004)<br>IEEE C.57.12.90: (2010) | Qualitative<br>(All Transformers 5 kVA to 3333 kVA, 36 kV) |
| | | Vector Group Verification<br>(3 Phase Transformers Only) | IS 2026-1: (2011)<br>IS 11171: (1985)<br>IEC 60076-1: (2011)<br>CEI EN 60076-1: (2015)<br>IEC 60076-11: (2004)<br>IEEE C.57.12.90: (2010) | Qualitative |

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|---|---|---|---|---|
| | **Power & Distribution Transformers Single And Three Phase Transformers Single Phase Oil Filled Transformers (5 kVA to 3333 kVA, 36 kV) Three Phase Oil Filled Transformers (6.3 kVA to 20000 kVA, 36 kV) Dry Type Transformers (25 kVA to 8000 kVA, 36 kV)** | Winding Resistance | IS 2026-1: (2011)<br>IS 11171: (1985)<br>IEC 60076-1: (2011)<br>CEI EN 60076-1: (2015)<br>IEC 60076-11: (2004)<br>IEEE C.57.12.90: (2010) | 0.1 mΩ to 300 Ω |
| | | No Load Loss And No Load Current | IS 2026-1: (2011)<br>IS 11171: (1985)<br>IEC 60076-1: (2011)<br>CEI EN 60076-1: (2015)<br>IEC 60076-11: (2004)<br>IEEE C.57.12.90: (2010) | 1 W to 20 kW<br>0.02 mA to 80 A |
| | | Short-Circuit Impedance And Load Loss | IS 2026-1: (2011)<br>IS 11171: (1985)<br>IEC 60076-1: (2011)<br>CEI EN 60076-1: (2015)<br>IEC 60076-11: (2004)<br>IEEE C.57.12.90: (2010) | 2 % to 15 % Impedance and 25 W to 110 kW load loss |
| | | Separate Source Voltage Withstand<br>Or<br>Applied Voltage | IS 2026-3: (2009)<br>IS 11171: (1985)<br>IEC 60076-3: (2013)<br>CEI EN 60076-3: (2015)<br>IEC 60076-11: (2004)<br>IEEE C.57.12.90: (2010) | 3 kV to 100 kV |
| | | Induced Over Voltage Withstand (Or) Induced Voltage Withstand | IS 2026-3: (2009)<br>IS 11171: (1985)<br>IEC 60076-3: (2013)<br>CEI EN 60076-3: (2015)<br>IEC 60076-11: (2004)<br>IEEE C.57.12.90: (2010)<br>IEEE C.57.12.20: (2011) | 100 Hz, 125 Hz, 150 Hz , 200 Hz |

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|---|---|---|---|---|
| | **Power & Distribution Transformers Single And Three Phase Transformers Single Phase Oil Filled Transformers (5 kVA to 3333 kVA, 36 kV) Three Phase Oil Filled Transformers (6.3 kVA to 20000 kVA, 36 kV) Dry Type Transformers (25 kVA to 8000 kVA, 36 kV)** | Temperature Rise | IS 2026-2: (2010)<br>IS 11171: (1985)<br>IEC 60076-2: (2011)<br>CEI EN 60076-2: (2015)<br>IEC 60076-11: (2004)<br>IEEE C.57.12.90: (2010) | 5 °C to 150 °C |
| | | Zero Sequence Impedance(S) On 3 Phase Transformers | IS 2026-1: (2011)<br>IS 11171: (1985)<br>IEC 60076-1: (2011)<br>CEI EN 60076-1: (2015)<br>IEC 60076-11: (2004)<br>IEEE C.57.12.90: (2010) | 2 % to 15 % |
| | | Sound Level | IS 2026-10: (2009)<br>IS 11171: (1985)<br>CEI EN 60076-1: (2015)<br>IEC :60076-10: (2016)<br>IEEE C.57.12.90: (2010) | 30 dB to 80 dB<br>All transformers<br>5 kVA to 20,000 kVA, 66 kV |
| | | Unbalance Current Measurement (3 Phase Transformers Only) | CBIP Manual: 2013<br>Page. 56 Clause. 6.3 | 8 mA to 100A |
| | | Vacuum<br>(For Oil Filled Transformers Only) | CBIP Manual-2013:Section-C 10,Page 91 & 92<br>IS1180-1: (2014)<br>IEC 60076-1: (2011) | 250 mm of Hg to 760 mm of Hg |
| | | Air Pressure<br>(For Oil Filled Transformers Only) | CBIP Manual-2013:Section-C 10,Page 91 & 92<br>IS1180-1: (2014)<br>IS 2026-1: (2011)<br>IEC 60076-1: (2011) | 0.2 $kg/cm^2$ to 2 $kg/cm^2$ |

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|---|---|---|---|---|
| | **Power & Distribution Transformers Single And Three Phase Transformers Single Phase Oil Filled Transformers (5 kVA to 3333 kVA, 36 kV) Three Phase Oil Filled Transformers (6.3 kVA to 20000 kVA, 36 kV) Dry Type Transformers (25 kVA to 8000 kVA, 36 kV)** | Lightning Impulse Voltage Withstand | IS 2026-3: (2009)<br>IS 11171: (1985)<br>IEC 60076-3: (2013)<br>CEI EN 60076-3: (2015)<br>IEC 60076-11: (2004)<br>IEEE C.57.12.90: (2010) | 10 kVp to 250 kVp<br><br>All transformers<br>5 kVA to 2 MVA<br>36 kV Class |
| | | Capacitance Windings-To-Earth And Between Windings & Dissipation Factor of The Insulation System Capacitances | IS 2026-1: (2011)<br>IEC :60076-1: (2011)<br>CEI EN 60076-1: (1998) | 1000 PF to 0.25 µF<br>0.1 % to 199.9 % |
| | | Partial Discharge Measurement | IS: 11171: (1985)<br>IEC 60076-11: (2004) | 5 pC to 50,000 pC<br>All transformers 5 kVA to 8,000 kVA, 33 kV |
| | | On Load Tap Changers | IS 2026-1: (2011)<br>IEC 60076-1: (2011) | Qualitative |
| | | Permissible Flux Density And Over Fluxing | IS 1180-1: (2014) | At 110 % (or) 112.5 % of rated flux density |
| | | Harmonics of No Load Current | IEC 60076-1: (2000)<br>CEI EN 60076-1: (2015)<br>IS 2026-1: (2011) | Order of harmonics:<br>1st to 50th order |
| | | Magnetic Balance | CBIP Manual (Publication No:317)-2013: Section-J Cl 7.3 | 200 V to 1000 V |
| | | Specific Core Loss | IS 3024: 2006<br>IS-649:1997 | 0.05 W/kg to 15 W/kg |
| | | Accelerated Ageing | IS 3024: 2006<br>IS-649:1997 | 0.05 W/kg to 15 W/kg |

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|---|---|---|---|---|
| | **Power & Distribution Transformers Single And Three Phase Transformers Single Phase Oil Filled Transformers (5 kVA to 3333 kVA, 36 kV) Three Phase Oil Filled Transformers (6.3 kVA to 20000 kVA, 36 kV) Dry Type Transformers (25 kVA to 8000 kVA, 36 kV)** | Magnetic Polarization | IS 3024: 2006<br>IS-649:1997 | 0.5 A/m to 2 at 800 A/m field strength |
| | | Permeability | IS 3024: 2006<br>IS-649:1997 | 600 to 40000 on all grades of CRGO samples |
| | | Stacking Factor | IS 3024: 2006<br>IS-649:1997 | 92 % to 98 % on all grades of CRGO samples |
| | | Ductility [Bend ] | IS 3024: 2006<br>IS-649:1997 | 85 mm to 320 mm width of all grades of CRGO samples |
| | | Short Circuit Withstand | IS 2026-5: (2011)<br>IS: 11171: (1985)<br>CEI EN 60076-1: (1998)<br>IEC 60076-5: (2006)<br>IEC 60076-11: (2004)<br>IEEE C.57.12.00: (2010)<br>IEEE C.57.12.90: (2010) | 0.3 kA to 8.5 kA for 2 s<br>All Transformers<br>5 kVA to 100 kVA,<br>11 kV |
| **2.** | **EHV Power Transformers Upto 500 MVA, 420 kV Class** | D.C. Insulation Resistance Each Winding to Earth And Between Windings & Polarization Index | IS 2026-1: (2011)<br>IEC 60076-1: (2011) | 1 MΩ to 1 TΩ |
| | | Voltage Ratio and Phase Displacement | IS 2026-1: (2011)<br>IEC 60076-1: (2011) | 1 to 100 |
| | | Polarity (1ø Transformers Only) | IS 2026-1: (2011)<br>IEC 60076-1: (2011) | Qualitative |

| S. No. | Product / Material of Test | Specific Test Performed | Test Method Specification against which tests are performed | Range of Testing / Limits of Detection |
|---|---|---|---|---|
| | **EHV Power Transformers Upto 500 MVA, 420 kV Class** | Vector Group Verification (3 Ø Transformers Only) | IS 2026-1: (2011)<br>IEC 60076-1: (2011)<br>CBIP Manual-2013 Section-BB,Cl.No:3.2.2..2 | 200 V to 500 V |
| | | Winding Resistance | IS 2026-1: (2011)<br>IEC 60076-1: (2011) | 500 μΩ to 5Ω |
| | | No Load Loss And Current | IS 2026-1: (2011)<br>IEC 60076-1: (2011) | 1 kW to 300 kW<br>0.1 A to 200 A |
| | | Short Circuit Impedance And Load Loss | IS 2026-1: (2011)<br>IEC 60076-1: (2011) | 1 kW to 1300 kW |
| | | Separate Source Voltage Withstand Or Applied Voltage | IS 2026-3: (2009)<br>IEC 60076-3: (2013) | 25 kV to 500 kV |
| | | Induced Over Voltage Withstand Or Induced Voltage Withstand | IS 2026-3: (2009)<br>IEC 60076-3: (2013) | 40 kV to 600 kV.<br>Frequency range: at 175 Hz |
| | | Partial Discharge Measurement (Acld, Acsd & Ivpd) | IS 2026-3: (2009)<br>IEC 60076-3: (2013) | 10 pC to 500 pC |
| | | Temperature Rise | IS 2026-2: (2010)<br>IEC 60076-2: (2011) | Temperature Scanner<br>(10 °C to 120 °C) |
| | | Zero Sequence Impedance (3 Ø Transformers Only) | IS 2026-1: (2011)<br>IEC 60076-1: (2011) | 5 % to 100 % |
| | | Acoustic Noise Level | IS 2026-10: (2016)<br>IEC 60076-10: (2016) | 50 dB to 90 dB |
| | | Harmonics of No-Load Current | IS 2026-1: (2011)<br>IEC 60076-1: (1999) | Up to 50$^{th}$ Harmonics<br>0.01 % of fundamental |

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|---|---|---|---|---|
| | **EHV Power Transformers Upto 500 MVA, 420 kV Class** | Lighting Impulse Voltage Withstand (Or) Full Wave Lightning Impulse For The Line Terminals (Or) Chopped Wave Lightning Impulse On Line Terminals | IS 2026-3: (2009)<br>IEC 60076-3: (2013) | 35 $kV_p$ to 2100 $kV_p$<br>450 kJ |
| | | Switching Impulse Voltage Withstand (Or) Switching Impulse for Line Terminals | IS 2026-3: (2009)<br>IEC 60076-3: (2013) | 35 $kV_p$ to 1200 $kV_p$<br>450 kJ |
| | | Capacitances Windings-To-Earth And Between Windings And Measurement of Dissipation Factor (Tan Δ) of The Insulation System Capacitances | IS 2026-1: (2011)<br>IEC 60076-1 : (2011)<br>CBIP Manual of Transformers-2013 Section J, Clause. 6.9 | 100 pF to 30 nF for capacitance and Upto 199.0 % for Tan Delta |
| | | Magnetic Balance | CBIP Manual of Transformers-2013, Section BB, Clause. 3.17 | 230 Volts and 415 Volts |
| | | Magnetizing Current At Low Voltage | CBIP Manual of Transformers-2013, Section BB Clause. 3.23 | 0.1 mA to 1 A |
| | | Power Taken By Fans And Liquid Pump Motors | IS 2026-1: (2011)<br>IEC 60076-1: (2011) | 100 W to 25 kW |
| | | Sweep Frequency Response Analysis | IEC 60076-18: (2011) | 20 Hz to 2 MHz |
| | | On-Load Tap Changers | IS 2026-1: (2011)<br>IEC 60076-1: (2011) | NA |
| | | Check of Core to Frame Insulation For Liquid Immersed Transformers | IEC 60076-1: (2011)<br>CBIP Manual on Transformers-2013, Section BB, Clause. 3.15 | 0.1 kV to 12 kV |

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|---|---|---|---|---|
| **II.** | **ELECTRICAL MATERIALS -LIQUID DIELECTRIC MATERIALS** | | | |
| **1.** | **New Insulating Oil** | Appearance | IS 335: (1993)<br>IEC 60296: (2012) | Qualitative |
| | | Density | IS 1448-16: (2014)<br>ISO 3675: (1998) | 0.8 g/cc to 0.85 g/cc<br>0.85 g/cc to 0.90 g/cc |
| | | Kinematic Viscosity | IS 1448-25: (1976) | 1cst to 100 cst |
| | | Interfacial Tension | IS 6104: 1971<br>ISO 6295: 1983 | 0.003 N/m to 0.090 N/m |
| | | Flash Point | IS 1448-21: (2012)<br>ISO 2719: (2002) | RT-370°C |
| | | Pour Point | IS 1448-10: (1970)<br>ISO 3016: (1994) | (-)40 ˚C to (+)10 ˚C |
| | | Neutralization Value. | IS 1448-2: (2007) | 0.0028 mg KOH/g to 10 mg KOH |
| | | Corrosive Sulphur | IS 335: (1993) Annexure B | Qualitative |
| | | Electric Strength | IS 6792: (1992)<br>IEC 60156: (1995) | 20 kV to 100 kV |
| | | Dielectric Dissipation Factor | IS 6262: (1971)<br>IEC 60247: (2004) | 0.0001 to 10 |
| | | Specific Resistance | IS 6103: (1971) | 1 x $10^9$ Ω-cm to 1 x $10^{18}$ Ω-cm |

| S. No. | Product / Material of Test | Specific Test Performed | Test Method Specification against which tests are performed | Range of Testing / Limits of Detection |
|---|---|---|---|---|
| | **New Insulating Oil** | Oxidation Stability<br>Total Acidity<br>Total Sludge | IS 335: (1993) Annexure C | 0.0028 mg KOH/g to 10 mg KOH/g<br>0.001 % to 10 % by weight |
| | | Ageing Characteristics<br>Specific Resistance@27ºC | IS 12177: (1987) | $1 \times 10^{9}$ to $1 \times 10^{18}$ |
| | | Specific Resistance @90ºC | | $1 \times 10^{9}$ to $1 \times 10^{18}$ |
| | | Dielectric Dissipation Factor@90ºc | | 0.00008 to 10 |
| | | Total Acidity | | 0.0028 mg KOH/g to 10 mg KOH |
| | | Total Sludge | | 0.001 % to 10 % by weight |
| | | Presence of Oxidation Inhibitor | IS 13631 Section-1: (1993) | Qualitative |
| | | Water Content | IS 13567: (1992)<br>IEC:60814: (1997) | 1 mg/kg to 5000 mg/kg |
| **2.** | **Mineral Insulating Oil** | Appearance | IS 335: (1993)<br>IEC 60296: (2012) | Qualitative |
| | | Density | IS 1448-16: (2014)<br>ISO 3675: (1998) | 0.8 g/cc to 0.85 g/cc<br>0.85 g/cc to 0.90 g/cc |
| | | Kinematic Viscosity | IS 1448-25: (1976) | 1 cst to 100 cst |

| S. No. | Product / Material of Test | Specific Test Performed | Test Method Specification against which tests are performed | Range of Testing / Limits of Detection |
|---|---|---|---|---|
| | **Mineral Insulating Oil** | Interfacial Tension | IS 6104: (1971)<br>ISO 6295: (1983) | 0.003 N/m to 0.090 N/m |
| | | Flash Point | IS 1448-21: (2012)<br>ISO:2719: (2002) | 50 °C to 370 °C |
| | | Pour Point | IS 1448-10: (1970)<br>ISO 3016: (1994) | (-)40˚C to (+)10 ˚C |
| | | Neutralization Value. | IS 1448-2: (2007) | 0.0028 mg KOH/g to 10 mg KOH/g |
| | | Electric Strength | IS 6792: (1992)<br>IEC 60156: (1995) | 20 kV to 100 kV |
| | | Dielectric Dissipation Factor | IS 6262: (1971)<br>IEC 60247: (2004) | 0.0001 to 10 |
| | | Specific Resistance | IS 6103: (1971) | 1 x $10^{9}$ Ω-cm to 1 x $10^{18}$ Ω-cm |
| | | Oxidation Stability<br>Total Acidity<br>Total Sludge | IS 335: (1993) Annexure C | (0.0028 mg to 10 mg) KOH/g<br>0.001 % to 10 % by weight |
| | | Water Content | IS 13567: (1992)<br>IEC 60814: (1997) | 1 mg/kg to 5000 mg/kg |

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| **III.** | **CONDUCTORS** | | | |
| | | | IS 13730-0-1, IEC 60317-0-1<br>IS 13730-0-2, IEC 60317-0-2<br>IS 13730-0-3, IEC 60317-0-3<br>IEC 60317-0-9, IS 7401-1<br>IS 13730-27, IS 6162-1<br>IS 6162-2 | |
| **1.** | **Enameled Round Copper Wire**<br>**Enameled Rectangular Copper Wire**<br>**Enameled Round Alluminium Wire**<br>**Enameled Rectangular Alluminium Wire**<br>**Paper Covered Round Copper Wire,**<br>**Paper Covered Rectangular Copper Wire**<br>**Paper Covered Round Alluminium Wire**<br>**Paper Covered Aluminium Rectangular Wire** | Dimensional Check | IS 13778-2: 2013 Clause. 3<br>IEC 60851-2: 2009 Clause. 3 | 0.01 mm to 25 mm |
| | | Measurement of Electrical Resistivity | IS 13778-5: 2012 Clause. 3<br>IEC 60851-5: 2008 Clause. 3 | 0 to 0.018 Ω-mm $^2$/m |
| | | Elongation | IS 13778-3: 2012 Clause. 3<br>IEC 60851-3: 2009 Clause. 3 | 10 % to 50 % |
| | | Springiness | IS 13778-3: 2012 Clause. 4<br>IEC 60851-3: 2009 Clause. 4 | 5 ° to 72 ° |
| | | Flexibility And Adherence | IS 13778-3: 2012 Clause. 5<br>IEC 60851-3: 2009 Clause. 5 | Upto 20 % |
| | | Heat Shock | IS 13778-6: 2011 Clause. 3<br>IEC 60851-6: 2012 Clause. 3 | Upto 200 ºC |
| | | Cut Through | IS 13778-6: 2011 Clause. 4<br>IEC 60851-6: 2012 Clause. 4 | Qualitative |
| | | BDV | IS 13778-5: 2012 Clause. 4<br>IEC 60851-5: 2008 Clause. 4 | 0.15 kV to 20 kV (AC) |
| | | Peel / Jerk | IS 13778-3: 2012 Clause. 5<br>IEC 60851-3: 2009 Clause. 5 | Upto 200 rpm |
| | | Corner Radius | IS 13778-2: 2013 Clause. 3<br>IEC 60851-2: 2009 Clause. 3 | 0.50 mm to 1.0 mm |
| | | Pin Hole (Continuity of Insulation) | IS 13778-5: 2012 Clause. 5<br>IEC 60851-5: 2008 Clause. 5 | 0 to 30 faults |

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|---|---|---|---|---|
| | | Resistance to Abrasion | IS 13778-3: 2012 Clause. 6<br>IEC 60851-3: 2009 Clause. 6 | 3.0 N to 15.7 N |
| **IV.** | **SWITCHGEAR EQUIPMENT** | | | |
| **1.** | **Switchgear Products: Vacuum Circuit Breakers (12 kV to 36 kV) & AC Metal-Enclosed Switchgear And Control Gear (12 kV)** | Dielectric On The Main Circuit | IEC 62271-100: (2012)<br>IEC 62271-200: (2011)<br>IS 13118: (1991) | 1 kV to 90 kV rms |
| | | Auxiliary And Control Circuits | | 0.01 kV to 5 kV rms |
| | | Resistance of The Main Circuit | | 20 μΩ to 200 μΩ<br>10 A to 100 A |
| | | Design And Visual Checks | | Qualitative |
| | | Mechanical Operating | | Timing:<br>0.5 ms to 200 ms<br>Travel:<br>0.5 mm to 50 mm<br>velocity:<br>0.01 m/s to 2 m/s<br>Coil voltage:<br>1 V to 300 V<br>(AC& DC)<br>M2 Class<br>(10000 Operations) |
| | | Temperature-Rise | | 100 A to 1600 A |
| **2.** | **Switchgear Products: Current Transformers (12 kV to 420 kV) 25a to 2400a Accuracy Class: 0.2 s** | Secondary Winding Resistance (Rct) | IEC 61869-2: (2012)<br>IS 2705 (Part 1, 2, 3 & 4): 1992 | 0.5 Ω to 10 Ω |
| | | Rated Knee Point E.M.F. (Ek) and Exciting Current At Ek | IEC 61869-2: (2012)<br>IS 2705 (Part 1 & 4): 1992 | 1 V to 5 kV,<br>1 mA to 10 A |
| | | Inter-Turn Overvoltage | IEC 61869-2: (2012)<br>IS 2705 (Part 1): 1992 | 0.05 kV to 5 kV,<br>0.01 A to 5 A |

| S. No. | Product / Material of Test | Specific Test Performed | Test Method Specification against which tests are performed | Range of Testing / Limits of Detection |
|---|---|---|---|---|
| | **Switchgear Products: Current Transformers (12 kV to 420 kV) 25a to 2400a Accuracy Class: 0.2 s** | Power-Frequency Voltage Withstand | IEC 61869-1: (2007)<br>IEC 61869-2: (2012)<br>IS 2705 (Part 1): 1992 | 1 kV to 700 kVrms |
| | | Partial Discharge Measurement | IEC 61869-1: (2007)<br>IEC 61869-2: (2012)<br>IS 2705 (Part 1): 1992 | 2 pC to 10000 pC |
| | | Accuracy<br>Ratio Error & Phase Displacement<br>Instrument Security Factor<br>Composite Error Measurement | IEC 61869-2: (2012)<br>IS 2705 (Part 1, 2, 3 & 4): 1992 | RE%:<br>(±) 0.0001 % to 20 %,<br>PE:<br>(±) 0.01 min to 680 min.<br>1 mV to 5 kV,<br>1 mA to 10 A |
| | | Verification of Markings | IEC 61869-1: (2007)<br>IS 2705 (Part 1): 1992 | Qualitative |
| | | Measurement of Capacitance And Dielectric Dissipation Factor | IEC 61869-1: (2007)<br>IEC 61869-2: (2012)<br>IS 2705 (Part 1): 1992 | Tan delta:<br>0.00001 to 1.0<br>Capacitance:<br>0.000001 µF to 0.065 µF |
| **3.** | **Voltage Transformers (12 kV to 245 kV) Burden:300 VA, Accuracy Class:0.2** | Induced AC Voltage & Power Frequency Voltage Withstand | IEC 61869-1: (2007)<br>IEC 61869-3: (2011)<br>IS 3156 (Part 1): 1992 | 3 kV to 500 kV,125 Hz |
| | | Partial Discharge Measurement | IEC:61869-1: (2007)<br>IEC:61869-3: (2011)<br>IS 3156 (Part 1): 1992 | 2 pC to 10000 pC |
| | | Accuracy | IEC 61869-3: (2011)<br>IS 3156 (Part 1, 2 & 3): 1992 | RE%:<br>(±)0.0001 % to 20 % ,<br>PE:<br>(±) 0.01 min to 680 min. |

| S. No. | Product / Material of Test | Specific Test Performed | Test Method Specification against which tests are performed | Range of Testing / Limits of Detection |
|---|---|---|---|---|
| | **Voltage Transformers (12 kV to 245 kV) Burden:300 VA, Accuracy Class:0.2** | Verification of Markings | IEC 61869-1: (2007)<br>IS 3156 (Part 1): 1992 | Qualitative tests |
| | | Capacitance And Dielectric Dissipation Factor | IEC 61869-1: (2007)<br>IEC 61869-3: (2011) | 0.00001 to 1.0<br>0.000001 µF to 0.065µF |
| **4.** | **Switchgear Products: Condenser Bushings (52 kV to 245 kV)** | Dielectric Dissipation Factor (Tan Δ) And Capacitance At Ambient Temperature | IEC 60137: 2008<br>IS 2099: 1986 | 0.00001 to 1.0<br>0.000001 µF to 0.065µF |
| | | Dry Power-Frequency Voltage Withstand | IEC 60137: 2008<br>IS 2099: 1986 | 105 kV to 700 kVrms |
| | | Partial Discharge Quantity | IEC 60137: 2008<br>IS 2099: 1986 | 2 pC to 100000 pC |
| | | Tap Insulation | IEC 60137: 2008<br>IS 2099: 1986 | 0.01 kV to 5 kVrms<br>0.000001 µF to 0.26µF<br>0.00001 to 1.00 |
| | | Tightness On Liquid-Filled, Compound-Filled And Liquid-Insulated Bushings | IEC 60137: 2008<br>IS 2099: 1986 | 0.1 $kg/cm^2$ to 4 $kg/cm^2$ |
| | | Visual Inspection and Dimensional Check | IEC 60137: 2008<br>IS 2099: 1986 | Qualitative |

| S. No. | Product / Material of Test | Specific Test Performed | Test Method Specification against which tests are performed | Range of Testing / Limits of Detection |
|---|---|---|---|---|
| | | **AT SITE** | | |
| **I.** | **TRANSFORMERS AND REACTORS** | | | |
| **1.** | **Power & Distribution Transformers Power & Distribution Transformers Single And Three Phase Single Phase Oil Filled Transformers (5 kVA to 200 kVA, 36 kV) Three Phase Oil Filled & Dry Type Transformers (6.3 kVA to 1000 kVA, 36 kV)** | Winding Resistance | IS 2026-1: (2011)<br>IS 11171: (1985)<br>IEC 60076-1: (2011)<br>IEC 60076-11: (2004) | 0.5 mΩ to 500 Ω |
| | | Insulation Resistance | IS 2026-1: (2011)<br>IEC 60076-1: (2011)<br>IS 11171: (1985) | 0.1 MΩ to 1 TΩ<br>(At 500 V,1 kV,2.5 kV & 5 kV)<br>All Transformers |
| | | Impedance And Load Loss | IS 2026-1: (2011)<br>IS 11171: (1985)<br>IEC 60076-1: (2011)<br>IEC 60076-11: (2004) | 1 % to 10 % Impedance<br>1 W to 15 kW load loss |
| | | No Load Loss And No Load Current | IS 2026-1: (2011)<br>IS 11171: (1985)<br>IEC 60076-1: (2011)<br>IEC 60076-11: (2004) | 1 k W to 50 kW<br>0.01 mA and 40 A |
| | | Ratio | IS 2026-1: (2011)<br>IS 11171: (1985)<br>IEC 60076-1: (2011)<br>IEC 60076-11: (2004) | Qualitative<br>(Ratio 1 to Ratio 150) |

**-X-X-X-X-X-X-X-X-X-X-X-X-X-X-**