

Laboratory **CG Power and Industrial Solutions Limited, (T3-Transformer Division),  
29, 31, 32, New Industrial Area, Mandideep, Raisen, Madhya Pradesh**

Accreditation Standard **ISO/IEC 17025: 2005**

Certificate Number **TC-6663**

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Validity **13.04.2018 to 12.04.2020**

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Sl.	Product / Material of Test	Specific Test Performed	Test Method Specification against which tests are performed	Range of Testing / Limits of Detection
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**ELECTRICAL TESTING**

I.	<b>TRANSFORMERS AND REACTORS</b>			
1.	<b>Power &amp; Auto Transformer- upto 500MVA,765kV, 1 Phase &amp; 500 MVA, 3 Phase , 650 kV</b>	Voltage Ratio	IEC 60076-01 : 2011 (Clause 10.3) IS 2026-01 : 2011 (Clause 10.3) IEEE C57.12.00 : 2010 (Table 18)	1 to 1900
		Check of Winding polarity / Check of Vector group	IEC 60076-01 : 2011 (Clause 10.3) IS 2026-01 : 2011 (Clause 10.3) Table 18 of IEEE C57.12.00 : 2010	All Vector Groups specified in standards; Voltage : 0.1V to 415 V
		Winding resistance	IEC 60076-01 : 2011 (Clause 10.2) IS 2026-01 : 2011 (Clause 10.2) IEEE C57.12.00 : 2010 (Table 18)	40 $\mu\Omega$ to 100 $\Omega$
		Capacitance	IEC 60076-01 : 2011 (Clause 10.1.3 (b))	124 pF to 50000 pF
		Tan Delta	IS 2026-01 : 2011 (Clause 10.1.3 (b)) IEEE C57.12.00 : 2010 (Table 18)	0.000196 V to 1 V
		Magnetic Balance test	CBIP SECTION - BB : 2013 (Clause 3.17)	0.1 V to 415 V
		Insulation Resistance of Windings, Core, Frame & Tank.	IEC 60076-01: 2011 (Clause 10.1.3 (i)) IS 2026-01: 2011 (Clause 10.1.3 (i))	0.1 M $\Omega$ to 1 T $\Omega$

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			IEEE C57.12.90 : 2010 (Clause. 10.11)	
		No load losses and Current	IEC 60076-01 : 2011 (Clause 10.5) IS 2026-01 : 2011 (Clause 10.5) IEEE C57.12.90 : 2010 (Clause.8)	Losses 1 KW to 300 KW with test voltage 6.6 kV to 90 kV
		Short-circuit impedance and Load loss	IEC 60076-01 : 2011 (Clause 10.4) IS 2026-01 : 2011 (Clause 10.4) IEEE C57.12.90 : 2010 (Clause.9)	Losses 1 KW to 1200KW with impedance 5% to 70%
		Full wave lightning impulse test for the line terminals (LI)	IEC 60076-03 : 2013 (Clause 13.2) IS 2026-03 : 2009 (Clause 13) IEEE C57.12.90 : 2010 (Clause.10.3)	Voltage: 30 KVp to 2800 KVp
		Chopped wave lightning impulse test for the line terminals (LIC)	IEC 60076-03 : 2013 Clause 13.3 IS 2026-03 : 2009 Clause 14 IEEE C57.12.90 : 2010 Clause.10.3	Voltage: 30 KVp to 2800 KVp
		Lightning impulse test for the neutral terminals (LIN)	IEC 60076-03 : 2013 (Clause 13.4) IS 2026-03 : 2009 (Clause 13.3.2) IEEE C57.12.90 : 2010 (Clause.10.3)	Voltage: 30 KVp to 2800 KVp
		Switching impulse test for the line terminal (SI)	IEC 60076-03 : 2013 (Clause 14) IS 2026-03:2009	Voltage: 30 KVp to 2800 KVp

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			(Clause 15) IEEE C57.12.90 : 2010 (Clause.10.2)	
		Applied voltage test (AV) / Separate source AC withstand voltage test	IEC 60076-03 : 2013 (Clause 10) IS 2026-03 : 2009 (Clause 11) IEEE C57.12.90 : 2010 (Clause.10.6)	Voltage: 15 kVrms to 600 kVrms
		Induced voltage withstand test (IVW)	IEC 60076-03 : 2013 (Clause 11.2) IS 2026-03 : 2009 (Clause 12) IEEE C57.12.90 : 2010 (Clause.10.8)	Voltage: 15 kVrms to 600 kVrms
		Induced voltage test with PD measurement (IVPD)	IEC 60076-03 : 2013 (Clause 11.3) IS 2026-03 : 2009 (Clause 12.4) IEEE C57.12.90 : 2010 (Clause.10.8)	Voltage: 15 kVrms to 600 kVrms
		Line terminal AC withstand voltage test (LTAC)	IEC 60076-03 : 2013 (Clause 12) IS 2026-03 : 2009 (Clause 12.2 & 12.3)	Voltage: 15 kVrms to 600 kVrms
		Auxiliary wiring (AuxW) & Magnetic Circuit insulation test	IEC 60076-03 : 2013 (Clause 9) IS 2026-03 : 2009 (Clause 10) IEEE C57.12.00 : 2010 Table 18	Voltage: 1kV to 3 kV
		Tests on on-load tap-changers	IEC 60076-01 : 2011 (Clause 10.8) IS 2026-01 : 2011 (Clause 10.8)	Qualitative

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Sl.	Product / Material of Test	Specific Test Performed	Test Method Specification against which tests are performed	Range of Testing / Limits of Detection
		Temperature rise test	IEC 60076-02 : 2011 (Clause 7) IS 2026-02 : 1977 (Clause 4) IEEE C57.12.90 : 2010 (Clause.11)	Losses 1 kW to 1200 kW with impedance voltage 1kV to 90 kV
		Transient voltage transfer characteristics	IEC 60076-03 : 2013 (Clause B2) Annex-B IS 2026-03 : 2009 (Clause 13.3.3)	Voltage: 30 kVp to 500 kVp
		Sound levels	IEC 60076-10 : 2001 (Clause 11) IS 2026-01 : 2011 (Clause 10.1.3(f)) IEEE C57.12.90 : 2010 (Clause.13.5)	Noise Level: 50 db to 110 dB
		Zero-sequence impedance(s) on three-phase transformers	IEC 60076-01 : 2011 (Clause 10.7) IS 2026-01 : 2011 (Clause 10.7) IEEE C57.12.90 : 2010 (Clause.9.5)	Impedance: 5 % to 70%
		Harmonics of the no-load current	IEC 60076-01 : 2011 (Clause 10.6) IS 2026-01 : 2011 (Clause 10.6) IEEE C57.12.90 : 2010 (Clause.8)	Fundamental to 25 <sup>th</sup> harmonics of no load current
		Power taken by the fan and oil pump motors	IEC 60076-01 : 2011 (Clause 10.1.3(h)) IS 2026-01 : 2011 (Clause 10.1.3(h)) IEEE C57.12.00 : 2010 Table 18	Losses 1 kW to 50 kW

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Sl.	Product / Material of Test	Specific Test Performed	Test Method Specification against which tests are performed	Range of Testing / Limits of Detection
		Sweep Frequency Response Analysis (SFRA) Test	IEC 60076-18 : 2010	20 Hz to 2 MHz
2.	Reactors Upto 110MVA,765kV	Winding resistance	IEC 60076-06 : 2007 (Clause 7.8.2) IEC 60076-01 : 2011 (Clause 10.2) IS 2026-01 : 2011 (Clause 10.2) IEEE C57.12.00 : 2010 Table 18	40 $\mu\Omega$ to 100 $\Omega$
		Capacitance Tan Delta	IEC 60076-06 : 2007 (Clause 7.8.10) IEC 60076-01 : 2011 (Clause 10.1.3 (b)) IS 2026-01 : 2011 Clause 10.1.3 (b) IEEE C57.12.00 : 2010 Table 18	124 to 50000 pF 0.000196 to 0.1
		Insulation Resistance of Windings, Core, Frame and Shields.	IEC 60076-06 : 2007 (Clause 7.8.10) IEC 60076-01: 2011 (Clause 10.1.3 (i)) IS 2026-01: 2011 (Clause 10.1.3 (i)) IEEE C57.12.90:2010 (Clause. 10.11)	0.1 M $\Omega$ to 1T $\Omega$
		Full wave lightning impulse test for the line terminals (LI)	IEC 60076-06 : 2007 (Clause 7.8.10) IEC 60076-03 : 2013 (Clause 13.2) IS 2026-03 : 2009 (Clause 13) IEEE C57.12.90 : 2010 (Clause.10.3)	Voltage: 30 kVp to 2800 kVp

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		Chopped wave lightning impulse test for the line terminals (LIC)	IEC 60076-06 : 2007 (Clause 7.8.10) IEC 60076-03 : 2013 (Clause 13.3) IS 2026-03 : 2009 (Clause 14) IEEE C57.12.90 : 2010 (Clause.10.3)	Voltage: 30 kVp to 2800 kVp
		Lightning impulse test for the neutral terminals (LIN)	IEC 60076-06 : 2007 (Clause 7.8.10) IEC 60076-03 : 2013 (Clause 13.4) IS 2026-03 : 2009 (Clause 13.3.2) IEEE C57.12.90 : 2010 (Clause.10.3)	Voltage: 30 kVp to 2800 kVp
		Switching impulse test for the line terminal (SI)	IEC 60076-06 : 2007 (Clause 7.8.10) IEC 60076-03 : 2013 (Clause 14) IS 2026-03 : 2009 (Clause 15) IEEE C57.12.90 : 2010 Clause.10.2	Voltage: 30 kVp to 2800 kVp
		Applied voltage test (AV) / Separate source AC withstand voltage test	IEC 60076-06 : 2007 (Clause 7.8.10) IEC 60076-03 : 2013 (Clause 10) IS 2026-03 : 2009 (Clause 11) IEEE C57.12.90 : 2010 (Clause.10.6)	Voltage: 15 kVrms to 600 kVrms
		Induced voltage withstand test (IVW)	IEC 60076-06 : 2007 (Clause 7.8.10) IEC 60076-03 : 2013	Voltage: 15 kVrms to 600 kVrms

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			(Clause 11.2) IS 2026-03 : 2009 (Clause 12) IEEE C57.12.90 : 2010 (Clause.10.8)	
		Induced voltage test with PD measurement (IVPD)	IEC 60076-06 : 2007 (Clause 7.8.10) IEC 60076-03 : 2013 (Clause 11.3) IS 2026-03 : 2009 (Clause 12.4) IEEE C57.12.90 : 2010 (Clause.10.8)	Voltage: 15 kVrms to 600 kVrms
		Line terminal AC withstand voltage test (LTAC)	IEC 60076-06 : 2007 (Clause 7.8.10) IEC 60076-03 : 2013 (Clause 12) IS 2026-03 : 2009 (Clause 12.2 & 12.3)	Voltage: 15 kVrms to 600 kVrms
		Auxiliary wiring (AuxW) & Magnetic Circuit insulation test	IEC 60076-06 : 2007 (Clause 7.8.3) IEC 60076-03 : 2013 (Clause 9) IS 2026-03 : 2009 (Clause 10) IEEE C57.12.00 : 2010 Table 18	Voltage: 1kV to 3 kV
		Temperature rise test	IEC 60076-06 : 2007 (Clause 7.8.14) IEC 60076-02 : 2011 (Clause 7) IS 2026-02 : 1977 (Clause 4) IEEE C57.12.90 : 2010 (Clause.11)	Losses 1 kW to 1200 kW with impedance Voltage 1kV to 90 kV, 0.75 Amps to 2000Amps, Temperature: 10°C to 100°C

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Convenor

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		Sound levels	IEC 60076-06 : 2007 (Clause 7.8.12) IEC 60076-10 : 2001 (Clause 11) IS 2026-01 : 2011 (Clause 10.1.3(f)) IEEE C57.12.90 : 2010 (Clause.13.5)	Noise Level: 50 db to 110 dB
		Harmonics of the no-load current	IEC 60076-06 : 2007 (Clause 7.8.7) IEC 60076-01 : 2011 (Clause 10.6) IS 2026-01 : 2011 (Clause 10.6) IEEE C57.12.90 : 2010 (Clause.8)	Fundamental to 25 <sup>th</sup> harmonics of no load current
		Power taken by the fan and oil pump motors	IEC 60076-06 : 2007 (Clause 7.8.3) IEC 60076-01 : 2011 (Clause 10.1.3(h)) IS 2026-01 : 2011 (Clause 10.1.3(h)) IEEE C57.12.00 : 2010 Table 18	Losses: 1kW to 50 kW
		Sweep Frequency Response Analysis (SFRA) Test	IEC 60076-18 : 2010	20 Hz to 2 MHz
		Reactance & Loss	IEC 60076-06 : 2007 (Clause 7.8.5 & 7.8.6)	Losses upto 500 kW with test voltage upto 462 kV
		Vibration	IEC 60076-06 : 2007 (Clause 7.8.13)	2 µm to 200 µm
		Strain and Stress	IEC 60076-06 : 2007) (Clause 7.8.13)	2 µm to 6250 µm



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		Determination Linearity of reactance.	IEC 60076-06 : 2007 Clause 7.8.5.3	Test Current: Upto 800 A (DC)
3.	Loco Transformer Upto 7.5 MVA, 25kV	Voltage ratio	IEC 310: 1991-11 Clause 20	1 to 1900
		Winding resistance	IEC 310: 1991-11 Clause 19	40 $\mu\Omega$ to 100 $\Omega$
		Insulation Resistance of Windings.	IEC 60076-01: 2011 Clause 10.1.3 (i) IS 2026-01: 2011 Clause 10.1.3 (j) IEEE C57.12.90 : 2010 Clause. 10.11	0.1 M $\Omega$ to 1 T $\Omega$
		No load losses and Current	IEC 310: 1991-11 Clause 21.2	Losses 1 kW to 300 kW with test voltage 6.6 kV to 90 kV
		Short-circuit impedance and Load loss	IEC 310: 1991-11 Clause 22 & 23	Losses 1 kW to 1200 kW with impedance 5% to 70%
		Separate source AC withstand voltage test	IEC 310: 1991-11 Clause 36.2	Voltage: 15 kVrms to 600 kVrms
		Induced voltage withstand test (IVW)	IEC 310: 1991-11 Clause 26.1	Voltage: 15 kVrms to 600 kVrms
		Temperature rise test	IEC 310: 1991-11 Clause 25	Losses 1KW to 1200KW with impedance voltage 1kV to 90 kV
		Full wave lightning impulse test for the line terminals (LI)	IEC 60076-03 : 2013 Clause 13.2 IS 2026-03 : 2009 Clause 13 IEEE C57.12.90 : 2010 Clause.10.3	Voltage: 30 kVp to 2800 kVp

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II.	<b>ELECTRICAL MATERIALS - LIQUID DIELECTRIC MATERIALS</b>			
1.	<b>Mineral Oil</b>	Electric strength Breakdown voltage (BDV)	IEC 60156:1995 IS 6792 (2003 )	10 kV to 90 kV
		Water Content	IEC 60814:1997 IS 13567 (RA 2003)	1 mg/kg to 100 mg/kg
		Specific Resistance (Resistivity)	IEC 60247:2004 IS 6103 (RA 2006 )	1.1x10 <sup>9</sup> Ωcm to 1.1 x 10 <sup>15</sup> Ωcm
		Dielectric dissipation factor ( tan delta)	IEC 60247:2004 IS 6262 (RA 2006 )	0.02 % to 10.8 %
		Interfacial Tension	ASTM D0971-12:2012 IS 6104 (RA 2006)	10 mN/m to 60 mN/m
		Dissolved Gas Analysis		
		Hydrogen	IEC 60567:2005	100 ppm / 0.1 ppm
		CO <sub>2</sub>	IEC 60599:2007	100 ppm / 0.1 ppm
		CO	IEEE-C57.104 :1991	100 ppm / 0.1 ppm
		Hydrocarbons	ASTM D3612-02:2002	100 ppm / 0.1 ppm
	Particle count	ISO 4402:1992 & ISO 11171:2016	2 μm to 1000 μm	