Laboratory	**CGPISL Transformer Division Laboratories, CG Power and Industrial Solutions Ltd., Kanjurmarg, Mumbai, Maharashtra**		
Accreditation Standard	**ISO/IEC 17025: 2005**		
Certificate Number	**TC-6849**	**Page 1 of 9**	
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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

ELECTRICAL TESTING

I.	**TRANSFORMERS AND REACTORS**			
1.	**Three Phase 7.5 MVA to 500 MVA 6.9 kV to 400kV** **Single Phase 30.24 MVA to 350 MVA 27kV to 500kV** **Generating Transformer Single phase, 25 MVA to 270 MVA 11kV to kV: 400/ v3**	Voltage ratio	IS 2026 (Part 1): 2011 Cl.No.10.3 IEC60076-1 (2011) Cl.No.11.3 IEEE-C57.12.90 (2010) Cl.No.7.0	1.45 to 61
		Vector Group	IS 2026 (Part 1): 2011 Cl.No.10.3 IEC60076-1(2011)) Cl.No.11.3 IEEE-C57.12.90 (2010) Cl.No.6.0	230 V/440 V @ 50 Hz
		Check of polarity	IS 2026 (Part 1): 2011 Cl.No.10.3 IEC60076-1(2011)) Cl.No.11.3 IEEE-C57.12.90 (2010) Cl.No.6.0	230 V/440 V @ 50 Hz
		Magnetic Balance	As per CBIP 295	5 V /440 V @ 50 Hz
		Winding Resistance	IS 2026 (Part 1): 2011 Cl.No.10.2 IEC60076-1(2011)) Cl.No.11.2 IEEE-C57.12.90 (2010) Cl.No.5.3	157 µΩ to 9 Ω
		Insulation Resistance	IS 2026 (Part 1): 2011 Cl.No.10.1.3 (j) IEC60076-1(2011) Cl.No.11.1.2.2(b), Cl.No.11.1.4 (h)	460 MΩ to 26 GΩ @2 kV, 2.5 kV, 5 kV DC

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			IEEE-C57.12.90 (2010) Cl.No.10.11	
		Capacitance & Tan delta Insulation Power Factor	IS 2026 (Part 1): 2011 Cl.No.10.1.3 (b) IEC60076-1(2011) Cl.No.11.1.2.2 (a,c), Cl.No.11.1.4 (c,d) IEEE-C57.12.90 (2010) Cl.No.10.10	514 pF to 25 nF 0.054% to 10% @ 0.5 kV, 2 kV, 5 kV,10 kV
		Harmonics of no load Current	IS 2026 (Part 1): 2011 Cl.No.10.6	1st to 27th
		Load Loss	IS 2026 (Part 1): 2011 Cl.No.10.4 IEC60076-1(2011)) Cl.No.11.4 IEEE-C57.12.90 (2010) Cl.No.9.0	1.5 kW to 1275 kW 1A to 2500A 12 kV to 76 kV
		Impedance voltage	IS 2026 (Part 1): 2011 Cl.No.10.4 IEC60076-1(2011) Cl.No.11.4 IEEE-C57(2010)) Cl.No.9.0	12 kV to 76 kV
		OLTC	IS 2026 (Part 1): 2011 Cl.No.10.8 IEC60076-1(2011) Cl.No.11.7	Qualitative
		Zero phase sequence impedance on three phase transformers & reactors	IS 2026 (Part 1): 2011 Cl.No.10.7 IEC60076-1(2011) Cl.No.11.6 IEEE-C57.12.90 (2010) Cl.No.9.5	22A to 450 A 0.268 kV to 30 kV
		Temperature rise	IS 2026 (Part 1): 2011 Cl.No.10.1.2 (a)	1.5 kW to 1782 kW 59A to1760 A

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			IEC60076-2(2011) Cl.No.11.1.3 (a) IEEE-C57.12.90 (2010) Cl.No.11	13 kV to 63 kV, Ambient to 110^{o} C
		Separate Source voltage withstand	IS 2026 (Part 1): 2011 Cl.No.11	10kV to 460kV
		Applied Voltage	IEEE-C57.12.90 (2010) Cl.No.10.6 IEC60076-3-(2018) Cl.No.7.2.3 (C)	10kV to 460kV
		Line terminal AC Withstand (LTAC) Induced Voltage Withstand (IVW)	IEC60076-1(2011)& Cl.No.7.2.3 (d) IEEE-C57.12.90 (2010) Cl.No.10.7 IEC60076-3-(2018) Cl.No.7.2.3 (e)	10kV to 630kV @ 200 Hz
		ACSD/ACLD voltage withstand with PD Induced Voltage with partial discharge (IVPD)	IS 2026 (Part 1): 2011 Cl.No.12.2,12.3, 12.4 IEEE-C57.12.90 (2010) Cl.No.10.9 IEC60076-3-(2018) Cl.No.7.2.3 (d)	10kV to 630kV 10pC to 1000pC @ 200 Hz
		Lightning impulse (LI, LIC, LIN, LIMT)	IS 2026 (Part 1): 2011 Cl.No.13,13.3.2 IEEE-C57.12.90 (2010) Cl.No.10.3 IEC60076-3-(2018) Cl.No.7.2.3 (a)	10kVp to 1700kVp
		Switching impulse (SI)	IS 2026 (Part 1): 2011 Cl.No.15 IEEE-C57.12.90 (2010) Cl.No.10.2 IEC60076-3-(2018) Cl.No.7.2.3 (d)	10kVp to 1400kVp

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		Noise level Audible Sound Emission	IS 2026 (Part 1): 2011 Cl.No.10.1.3 (f) IEC60076-10(2016) IEEE-C57.12.90 (2010) Cl.No.13	74 dB(A) to 100 dB (A)
		Power taken by fan & pump (cooler loss)	IS 2026 (Part 1): 2011 Cl.No.10.1.3 (h)IEC60076-1 (2011) Cl.No.11.1.3 (C)	0.1 kW to 100 kW
		CT ratio error & phase angle error	IEC 61869-2 (2012)	R.E =-0.004 to 20 (%) P.E= 4 to 200 minute 1A to 2500A
		No load loss & Excitation current	IS 2026 (Part 1): 2011 Cl.No.10.5 IEC60076-1(2011) Cl.No.11.5 IEEE-C57.12.90 (2010) Cl.No.8.0	94.25 W to 150 kW 0.5 Ato120A 10kV to 40 kV
		SFRA	IEC60076-1 Cl.No.11.1.4 (l)	20Hz to 2MHz
2.	**Reactor** **Three phase** **125 MVAr,420 kV** **20 MVAr, 33 kV** **Single phase** **60 MVAr,** **500 kV** **5 MVAr,** **145 kV** **Single phase** **Neutral Grounding Reactor** **0.04 MVAr to 1.64 Mvar** **64 kV to 220 kV**	Winding Resistance	IS 5553 (Part 2): 1990 Cl.No.7.3 (a) IEC60076-6 (2007) Cl.No.7.8.2 IEEE-C57.12.90 (2010) Cl.No.5.3	157 µΩ to 9 Ω
		Insulation Resistance	IS 5553 (Part 2): 1990 Cl.No.7.3 (b), IEC60076-6(2007) Cl.No.7.8.2 IEEE-C57.12.90 (2010) Cl.No.10.11	460 MΩ to 26 GΩ, @2-2.5-5 kV D.C.
		Capacitance Tan delta	IS 5553 (Part 2): 1990 Cl.No.7.4 (h), IEC60076-6(2007) Cl.No.7.8.2/IEEE-C57.12.90 (2010) Cl.No.10.10	514 pF to 25 nF 0.054% to 10% 0.5 kV, 2 kV, 5 kV, 10 kV

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		Harmonics of NO LOAD Current	IS 5553 (Part 2): 1990 Cl.No.7.4 (e), IEC60076-6(2007) Cl.No.7.8.7	1st to 27th
		Loss & Reactance	IS 5553 (Part 2): 1990 Cl.No.7.3 (d), IEC60076-6(2007) Cl.No.7.8.5 ,7.8.6 IEEE-C57.12.90 (2010) Cl.No.8.0	24 A to 268A, 32 kV, Upto 462 kV
		Linearity of reactance	IS 5553 (Part 2): 1990 Cl.No.7.12, IEC60076-6(2007) Cl.No.7.8.5.3	10kV Up to 630kV per phase of reactor
		Zero sequence impedance on three phase reactors	IS 5553 (Part 2): 1990 Cl.No.7.4 (a), IEC60076-6(2007) Cl.No.7.8.8 IEEE-C57.12.90 (2010) Cl.No.9.5	22A to 450 A, 0.268 kV to 30 kV
		Temperature rise	IS 5553 (Part 2): 1990 Cl.No.7.2 (g), IEC60076-6(2007) Cl.No.7.8.14 IEEE-C57.12.90 (2010) Cl.No.11	1.5 kW to 200 kW 24 A to 268A 32 kV Up to 462 kV, Ambient to 110 º C
		Separate Source voltage withstand	IS 5553 (Part 2): 1990 Cl.No.7.11.1, IEC60076-6(2007) Cl.No.7.8.10.2 IEEE-C57.12.90 (2010) Cl.No.10.6 IEC60076-3-(2018)	10kV to460kV
		Induced over voltage	IS 5553 (Part 2): 1990 Cl.No.7.11.2,	10kV to630kV 10pC to 1000pC

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		Induced Voltage Withstand (IVW)& (IVPD)	IEC60076-6 (2007) Cl.No.7.8.10.3 IEEE-C57.12.90 (2010) Cl.No.10.9 IEC60076-3-(2018) Cl.No.7.2.3 (e) Cl.No.7.2.3 (e)	@200 Hz
		Lightning impulse (LI,LIC,LIN,LIMT)	IS 5553 (Part 2): 1990 Cl.No.7.11.3 , IEC60076-6(2007) Cl.No.7.8.10.4 IEEE-C57.12.90 (2010) Cl.No.10.7 IEC60076-3-(2013)&Cl.No.7.2.3 (a)	10 kVp to 1700kVp
		Switching impulse	IS 5553 (Part 2): 1990 Cl.No.7.11.4, IEC60076-6(2007) Cl.No.7.8.10.6 IEEE-C57.12.90 (2010) Cl.No.10.2 IEC60076-3-(2013) Cl.No.7.2.3 (d)	10 kVp to 1400kVp
		Noise level	IS 5553 (Part 2): 1990 Cl.No.7.13, IEC60076-6(2007) Cl.No.7.8.12 (IEC60076-10(2016) IEEE-C57.12.90 (2010) Cl.No.13	74 dB (A) to 100dB(A)
		Power taken by fan & pump (cooler loss)	IS 5553 (Part 2): 1990 Cl.No.7.4 (f), IEC60076-1(2011) Cl.No.11.1.3 (C)	0.1 kW to 100 kW

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		Vibration	IS 5553 (Part 2): 1990 Cl.No.7.14, IEC60076-6 (2007) Cl.No.7.8.13	1 to 750 micron
		CT ratio error & phase angle error RE PE	IEC61869-2 (2012)	 ±0.004 to 20 (%) 4 to 200 minute 1 A to 2500 A
		SFRA	IEC60076-1&Cl.No.11.1.4 (l)	20 Hz to 2 MHz
II.	**ELECTRICAL MATERIALS-SOLID INSULATING MATERIAL**			
1.	**Electrical Steel**	Surface Insulation Resistivity	ASTM 717- (1995), IEC 60404-11(1996) IS 649-(1997)	Upto 0.999 A
		Specific core loss	IEC 60404-2 (1996), ASTM A343 (1997), IS 649-(1997)	0.001 T to 2 T 0.001 W/kg to 2 W/kg
		A. C. Magnetization	IEC 60404-2 (1996), ASTM A343 (1997), IS 649:1997	1 A/m to 30000 A/m
		Ageing Characteristic at 250 °C for 24hrs. core loss	IS 649:1997	0.001 T to 2 T
		Stacking Factor	IS 649:1997	Upto 100 %
		Bend	IS 649:1997	Qualitative (One bend at 160°C)

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III.	**ELECTRICAL MATERIALS- LIQUID DIELECTRIC MATERIALS**			
1.	**Insulating Oil**	Density	ISO 3675-(1998) ASTM D1298 (2005) BS 148 (7.2): (1998) IS 1448 (Part 16): 1976	0.80 g/ml to1.00 g/ml
		Break Down Voltage	ASTM D 877: (2007) BS 148 (1998) (7.11) IEC 60156-07(1995), IS 6792 (1998)	Upto 100 kV AC
		Tan Delta	ASTM D 924: (2004) BS 148 (1998) (7.12) IEC 60247-02 (2004), IS 6262 (1996)	Upto 1
		Specific Resistivity at 27 °C & 90 °C	IS 6103 (1996)	$1x10^{9}$ Ω-cm to 10^{15} Ω-cm
		Water Content	ASTM D 1533: (2005) BS 148 (1998) (7.8) IEC 60814-1-(1997) IS 13567 : (1992)	0.1 mg/kg to 1000 mg/kg
		Neutralisation Value	ASTM D 974: (2007) BS 148 (1998) (7.6) IEC 62021-12(2001) IS 1448 -2 (1967)	Upto 100 mgKOH/g
		Inter Facial Tension	ASTM D 971 (2004) IS 6104 (1971) ISO 6295: (1983)	0.01 mN/m to 100 mN/m
		Kinematic Viscosity at 40° C	ASTM D 445:2006/BS 148 (1998) (7.3)/IEC 60814-1(1997)/IS 1448 -25 (1976)	Upto 100 cSt
		Kinematic Viscosity at 27° C	ASTM D 445: (2006) BS 148 (1998) (7.3) IEC 60814-1(1997) IS 1448-25 (1976)	Upto 100 cSt

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		Dissolved Gas Analysis (DGA) Hydrogen Oxygen Nitrogen Carbon Monoxide Methane Carbon Dioxide Acetylene Ethylene Ethane	IEC 60567 2011 IEC 61181 2012-03 Addition 2.1 ASTM 3612METHOD C	 1 µL/L to 10000 µL/L 1 µL/L to 50000 µL/L 1 µL/L to 50000 µL/L 1 µL/L to 10000 µL/L 1 µL/L to 10000 µL/L 1 µL/L to 10000 µL/L 1 µL/L to 10000 µL/L 1 µL/L to 10000 µL/L 1 µL/L to 10000 µL/L

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