



CGL/T1/TTR/ET10335/1A

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**Prolific Systems And technology ltd**ISO/IEC 17025  
NABL NO.T1620**Transformer (T1) Division**Smart solutions.  
Strong relationships**Final Inspection****W.O.No :** : **ET10335****Serial No :** : **ET10335/1A****Customer :** : **ZETDC****JOB RATING :** : **3P2WDualHV****REFERENCE STANDARD :** : **IEC:60076****CUSTOMER REFERENCE :** : **-****SCHEDULE OF TESTS :** : **AS PER SHEET 3****TESTING DATE :** : **05/06/2015 To 05/06/2015****DATE OF ISSUE :** : **05/06/2015****TESTED BY****CHECKED BY****APPROVED BY****WITNESSED BY**



CGL/T1/TTR/ET10335/1A

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Strong relationships**Date :** 24/06/2015**W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**Voltage Class [kV]****Phase** : Three**Winding Designation** : HV LV**Terminal Notations** : 1U1,1V1,1W1,N 2U1,2V1,2W1,N**Rated Capacity [MVA]****ONAN** : 20 20**ONAF** : 30 30**Rated Voltage[kV]** : 132 - 88 11**Rated Current[A]** : 131.22 - 196.83 1574.64**Rated Frequency[Hz]** : 50**Connections** : STAR STAR**Vector Group** : YNyn0**Type Of Tap Changer** : OLTC & OLTC**% Voltage Variation On****OLTC** : Taps Provided On HV Winding For Variation Of HV Voltage From 7% To -7% in 1% Steps in 14 Steps**Transformer Type** : Power Transformer**OLTC** : Taps Provided On HV Winding For Variation Of HV Voltage From 10.5% To -10.5% in 1.5% Steps in 14 Steps**Temp. Rise. Of Oil/Wdg (°C)** : 60 / 65

INSULATION LEVELS	LINE TERMINALS	NEUTRAL TERMINALS
HV	LI (FW/CW) - 650/950kVp SI : 750kVp	LI - 325kVp
LV	LI (FW/CW) - 95/95kVp	N.A.

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Strong relationships**Date :** 16/09/2015**W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**Tests Performed**

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**MVA :** 30    **Customer :** ZETDC

**MEASUREMENT OF VOLTAGE RATIO**

HV/LV(132/11kV)/1

TAP NO.	VOLTAGES (kV)		CAL. RATIO	MEASURED RATIO					
	HV	LV		1U1-N	%	1V1-N	%	1W1-N	%
				2U1-N	Error	2V1-N	Error	2W1-N	Error
1	141.2400	11.0000	12.8400	12.8410	0.008	12.8360	-0.031	12.8330	-0.055
2	139.9200	11.0000	12.7200	12.7110	-0.071	12.7130	-0.055	12.7120	-0.063
3	138.6000	11.0000	12.6000	12.6060	0.048	12.6080	0.063	12.6010	0.008
4	137.2800	11.0000	12.4800	12.4690	-0.088	12.4670	-0.104	12.4720	-0.064
5	135.9600	11.0000	12.3600	12.3690	0.073	12.3630	0.024	12.3600	0.000
6	134.6400	11.0000	12.2400	12.2360	-0.033	12.2360	-0.033	12.2300	-0.082
7	133.3200	11.0000	12.1200	12.1250	0.041	12.1280	0.066	12.1210	0.008
8(Nor)	132.0000	11.0000	12.0000	11.9980	-0.017	11.9960	-0.033	11.9980	-0.017
9	130.6800	11.0000	11.8800	11.8850	0.042	11.8900	0.084	11.8870	0.059
10	129.3600	11.0000	11.7600	11.7580	-0.017	11.7580	-0.017	11.7600	0.000
11	128.0400	11.0000	11.6400	11.6500	0.086	11.6500	0.086	11.6480	0.069
12	126.7200	11.0000	11.5200	11.5160	-0.035	11.5210	0.009	11.5200	0.000
13	125.4000	11.0000	11.4000	11.4110	0.096	11.4080	0.070	11.4100	0.088
14	124.0800	11.0000	11.2800	11.2920	0.106	11.2920	0.106	11.2940	0.124
15	122.7600	11.0000	11.1600	11.1810	0.188	11.1810	0.188	11.1820	0.197

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**MVA :** 30 **Customer :** ZETDC**MEASUREMENT OF VOLTAGE RATIO**

HV/LV(88/11kV)/2

TAP NO.	VOLTAGES (kV)		CAL. RATIO	MEASURED RATIO					
	HV	LV		1U1-N	%	1V1-N	%	1W1-N	%
				2U1-N	Error	2V1-N	Error	2W1-N	Error
1	97.2400	11.0000	8.8400	8.8350	-0.057	8.8330	-0.079	8.8350	-0.057
2	95.9200	11.0000	8.7200	8.7060	-0.161	8.7090	-0.126	8.7070	-0.149
3	94.6000	11.0000	8.6000	8.6000	0.000	8.5980	-0.023	8.5970	-0.035
4	93.2800	11.0000	8.4800	8.4700	-0.118	8.4690	-0.130	8.4780	-0.024
5	91.9600	11.0000	8.3600	8.3610	0.012	8.3610	0.012	8.3610	0.012
6	90.6400	11.0000	8.2400	8.2340	-0.073	8.2330	-0.085	8.2360	-0.049
7	89.3200	11.0000	8.1200	8.1120	-0.099	8.1230	0.037	8.1250	0.062
8(Nor)	88.0000	11.0000	8.0000	7.9950	-0.062	7.9960	-0.050	7.9950	-0.062
9	86.6800	11.0000	7.8800	7.8848	0.061	7.8840	0.051	7.8850	0.063
10	85.3600	11.0000	7.7600	7.7590	-0.013	7.7560	-0.052	7.7590	-0.013
11	84.0400	11.0000	7.6400	7.6470	0.092	7.6470	0.092	7.6470	0.092
12	82.7200	11.0000	7.5200	7.5200	0.000	7.5200	0.000	7.5190	-0.013
13	81.4000	11.0000	7.4000	7.4100	0.135	7.4090	0.122	7.4100	0.135
14	80.0800	11.0000	7.2800	7.2830	0.041	7.2810	0.014	7.2820	0.027
15	78.7600	11.0000	7.1600	7.1700	0.140	7.1690	0.126	7.1690	0.126

Results : All measured values are within  $\pm 0.5$  % tolerance of the specified values

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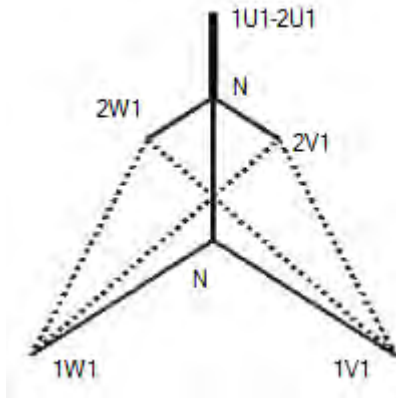


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**MVA :** 30    **Customer :** ZETDC

**VECTOR GROUP VERIFICATION**

**Shorted :** 1U1-2U1  
**3-Phase Supply :** 1U1-1V1-1W1



Measured		
1U1-1V1	429	Volts
1V1-1W1	428	Volts
1W1-1U1	435	Volts
1W1-2W1	389	Volts
1V1-2V1	393	Volts
1W1-2V1	406	Volts
1V1-2W1	409	Volts

(1W1-2W1) ≈ (1V1-2V1)	389 ≈ 393
(1W1-2V1) ≈ (1V1-2W1)	406 ≈ 409

Hence, Vector Group YNyn0 is confirmed.

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Strong relationships**Date :** 16/07/2015 **W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**MEASUREMENT OF WINDING RESISTANCE****HV (88 kV) Winding Resistance in Ohms**

Top Oil Temp. : 42.6°C Bottom Oil Temp. : 39.8°C Avg. Oil Temp. : 41.2°C					
TAP NO.	1U1-N	1V1-N	1W1-N	Avg. Resistance @ 41.2°C	Total Resistance @ 75 °C
1	0.478940	0.479260	0.480180	0.479460	1.614402
2	0.469860	0.470160	0.471200	0.470407	1.583919
3	0.461800	0.462220	0.463100	0.462373	1.556868
4	0.452820	0.453180	0.454220	0.453407	1.526678
5	0.444680	0.445240	0.446140	0.445353	1.499559
6	0.434980	0.435460	0.436460	0.435633	1.466831
7	0.426840	0.427460	0.428320	0.427540	1.439581
8(Nor)	0.416180	0.415900	0.416060	0.416047	1.400882
9	0.426340	0.427080	0.427940	0.427120	1.438167
10	0.435680	0.436320	0.437260	0.436420	1.469481
11	0.443680	0.444420	0.445200	0.444433	1.496462
12	0.452980	0.453640	0.454580	0.453733	1.527776
13	0.460900	0.461780	0.462440	0.461707	1.554625
14	0.469500	0.470300	0.471000	0.470267	1.583448
15	0.477560	0.478380	0.478980	0.478307	1.610520

**HV (132 kV) Winding Resistance in Ohms**

Top Oil Temp. : 42.6°C Bottom Oil Temp. : 39.8°C Avg. Oil Temp. : 41.2°C					
TAP NO.	1U1-N	1V1-N	1W1-N	Avg. Resistance @ 41.2°C	Total Resistance @ 75 °C
1	1.105500	1.106300	1.106800	1.106200	3.724713
2	1.096100	1.096900	1.097500	1.096833	3.693174
3	1.087800	1.088600	1.089200	1.088533	3.665226
4	1.078400	1.079200	1.079900	1.079167	3.633690
5	1.070100	1.070900	1.071500	1.070833	3.605628
6	1.060000	1.060800	1.061500	1.060767	3.571734
7	1.051600	1.052400	1.053100	1.052367	3.543453
8(Nor)	1.040500	1.040500	1.040400	1.040467	3.503382
9	1.051100	1.052000	1.052700	1.051933	3.541989
10	1.060800	1.061600	1.062400	1.061600	3.574539
11	1.069100	1.070000	1.070600	1.069900	3.602487
12	1.078700	1.079600	1.080300	1.079533	3.634923
13	1.087000	1.088000	1.088600	1.087867	3.662985
14	1.095900	1.096900	1.097500	1.096767	3.692952
15	1.104300	1.105200	1.105700	1.105067	3.720900

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**Serial No :** ET10335/1A

**MVA :** 30

**Customer :** ZETDC

**MEASUREMENT OF WINDING RESISTANCE**

**LV (11 kV) Winding Resistance in Ohms**

Top Oil Temp. : 42.6°C Bottom Oil Temp. : 39.8°C Avg. Oil Temp. : 41.2°C					
TAP NO.	2U1-N	2V1-N	2W1-N	Avg. Resistance @ 41.2°C	Total Resistance @ 75 °C
-	0.005980	0.005980	0.006020	0.005993	0.020178

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**Serial No :** ET10335/1A

**MVA :** 30

**Customer :** ZETDC

**MEASUREMENT OF INSULATION RESISTANCE OF WINDING**

**Top Oil Temp. : 42.60°C Bottom Oil Temp. : 39.80°C Avg. Oil Temp. : 41.2°C**

**Insulation Resistance in MegaOhms**

Measured Between	HV / LV + E	LV / HV + E	HV / LV
Test Voltage[Volts]	5000	5000	5000
<b>After Dielectric Tests</b>			
15 Seconds	8740	5930	8250
60 Seconds	12200	11000	13100
600 Seconds	18900	20200	29300
Absorption Index(60/15)	1.4	1.85	1.59
Polarisation Index(600/60)	1.55	1.84	2.24
<b>Before Dielectric Tests</b>			
15 Seconds	13900	8830	12600
60 Seconds	18600	16000	18700
600 Seconds	27900	35000	45200
Absorption Index(60/15)	1.34	1.81	1.48
Polarisation Index(600/60)	1.5	2.19	2.42

**Insulation Resistance in MegaOhms**

Terminal No.	Measured Between	Core/Frame	Core/Tank	Frame/Tank
	Test Voltage[Volts]	2500	2500	2500
<b>Before Dielectric Tests</b>				
1	60 Seconds	200	22	2
2	60 Seconds	50	55	5
<b>After Dielectric Tests</b>				
1	60 Seconds	200	2	22

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Strong relationships**Date :** 03/07/2015    **W.O.No :** ET10335    **Serial No :** ET10335/1A**MVA:** 30    **Customer :** ZETDC**MEASUREMENT OF NO LOAD LOSS AND NO LOAD CURRENT****Base MVA for % No-load Current ( MVA ) : 30****Tap Position No. : 8-8****Transformer Energised from : LV****After Dielectric Tests Date : 03/07/2015**

% kV	Freq. [Hz]	C.T.	R.M.S. Volt (kV)	Current Reading (Amp)				No Load Loss (kW)	No Load Current as % of rated Current	Corr. Losses (kW)
		Ratio	Avg. Volt (kV)	U	V	W	Avg.			
		P.T.		Power Reading (kW)						
		Ratio		W1	W2	W3	Total			
90	50.00	30/1	9.906	1.474	0.941	1.545	1.320	17.160	0.084	17.153
		33000/110	9.902	7.276	4.013	5.867	17.156			
100	50.00	30/1	11.030	2.785	1.856	2.891	2.511	24.110	0.159	24.049
		33000/110	11.002	11.576	5.598	6.931	24.105			
110	50.00	30/1	12.427	23.218	18.501	23.762	21.827	42.060	1.386	40.934
		33000/110	12.103	42.362	10.850	-11.150	42.062			

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Strong relationships**Date :** 25/06/2015 **W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**MEASUREMENT OF LOAD LOSS AND IMPEDANCE VOLTAGE****Combination Name : HV (132 kV)/LV**

<b>Supplied Winding : HV (132 kV)</b>	<b>Shorted Winding : LV</b>	<b>Base MVA : 30</b>
<b>C.T.Ratio : 500/1</b>	<b>P.T.Ratio : 22000/110</b>	
<b>Top Oil Temp : 35.30 °C</b>	<b>Bottom Oil Temp : 32.80 °C</b>	<b>Avg Oil Temp : 34.05 °C</b>

Tap Pos	Rated Parameters		Measured Voltage & Current		% of Rated Curr.	Measured Load Loss			Total Load Loss	Freq
	Volt.	Curr.	Volt.	Curr.		W1	W2	W3		
HV	[kV]	[A]	[V]	[A]		[W]	[W]	[W]	[kW]	[Hz]
1	141.240	122.640	16419.60	125.8900	102.65	46350	43350	37500	127.20	49.98
8	132.000	131.220	14468.90	131.3900	100.13	43950	39600	37050	120.60	50.02
15	122.760	141.100	13247.20	142.1200	100.72	47700	43800	42150	133.65	50.02

**Calculations****Supply Side : HV (132 kV) Short Circuit : LV Temperature [°C] : 34.05 °C****Measurement****Cooling Type : ONAF [30 MVA] Combination Name : HV (132 kV)/LV**

Tap Position	1	8	15						
Measured Impedance voltage [ Vm ]	[V]	16419.60	14468.90	13247.20					
Corrected Impedance Voltage at Rated Current	[V]	15995.71	14450.18	13152.12					
Applied Current [ ISc ]	A	125.89	131.39	142.12					
Rated Current [ IHR ]	A	122.64	131.22	141.10					
Measured Load Loss [ LLM ]	[W]	127200.00	120600.00	133650.00					
Corrected Load Loss At Rated Current [ LLC ]	[W]	120717.14	120288.12	131738.46					

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**MVA :** 30    **Customer :** ZETDC

**MEASUREMENT OF LOAD LOSS AND IMPEDANCE VOLTAGE****Cooling Type : ONAF [30 MVA]****Combination Name : HV (132 kV)/LV**

Tap Position			1	8	15						
Rated Current [ IHR ]	[HV]	A	122.64	131.22	141.10						
Rated Current [ ILR ]	[LV]	A	1574.64	1574.64	1574.64						
Avg. Resistance [ RhAvg ]	[HV]	at 41.2 °C	Ohms	1.106200	1.040467	1.105067					
Avg. Resistance [ RIAvg ]	[LV]	at 41.2 °C	Ohms	0.0059933	0.0059933	0.0059933					
Copper Loss[I <sup>2</sup> R] [ CLh ]	[HV]	at 41.2 °C	[W]	49913.63	53746.43	66003.03					
Copper Loss[I <sup>2</sup> R] [ CLI ]	[LV]	at 41.2 °C	[W]	44581.00	44581.00	44581.00					
Total Loss[I <sup>2</sup> R]		at 41.2 °C	[W]	94494.63	98327.43	110584.03					
Total Loss[I <sup>2</sup> R] [TCL]		at 34.05 °C	[W]	92031.34	95764.22	107701.32					
Corrected Load Loss [ LLC ]		at 34.05 °C	[W]	120717.14	120288.12	131738.46					
Stray Loss [SL =LLC - TCL ]		at 34.05 °C	[W]	28685.80	24523.90	24037.14					
% Z		at 34.05 °C	%	11.33	10.94	10.71					
% R		at 34.05 °C	%	402.39	400.96	439.13					
% X		at 34.05 °C	%	402.23	400.81	439.00					
Total Copper Loss[I <sup>2</sup> R]		at 75 °C	[W]	106058.42	110360.25	124116.76					
Stray Loss		at 75 °C	[W] At Test Freq	24891.87	21280.42	20858.03					
Stray Loss		at 75 °C	[W] @ 50 Hz	24911.80	21263.40	20841.36					
Load Loss		at 75 °C	[W] At Test Freq	130950.29	131640.67	144974.79					
Load Loss at [30 KVA]		at 75 °C	[W] @ 50 Hz	130970.22	131623.65	144958.12					
% X		at 75 °C	%	402.23	400.81	439.00					
% R		at 75 °C	%	436.50	438.80	483.25					
% Z at [30 KVA] at 50 Hz		at 75 °C	%	593.57	594.30	652.88					

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NABL NO.T1620**TEST CERTIFICATE**  
**Prolific Systems And technology ltd**  
**Transformer (T1) Division**Smart solutions.  
Strong relationships**Date :** 25/06/2015 **W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**MEASUREMENT OF LOAD LOSS AND IMPEDANCE VOLTAGE****Combination Name : HV (88 kV)/LV**

<b>Supplied Winding : HV (88 kV)</b>	<b>Shorted Winding : LV</b>	<b>Base MVA : 30</b>
<b>C.T.Ratio : 500/1</b>	<b>P.T.Ratio : 33000/110</b>	
<b>Top Oil Temp : 32.40 °C</b>	<b>Bottom Oil Temp : 30.50 °C</b>	<b>Avg Oil Temp : 31.45 °C</b>

Tap Pos	Rated Parameters		Measured Voltage & Current		% of Rated Curr.	Measured Load Loss			Total Load Loss	Freq
	Volt.	Curr.	Volt.	Curr.		W1	W2	W3		
HV	[kV]	[A]	[V]	[A]		[W]	[W]	[W]	[kW]	[Hz]
1	97.240	178.130	7472.50	138.5900	77.80	23940	22260	19970	66.17	49.96
8	88.000	196.830	7295.80	177.1500	90.00	30860	29940	27350	88.15	49.88
15	78.760	219.920	6064.80	189.5000	86.17	32240	32510	30530	95.28	49.81

**Calculations****Supply Side : HV (88 kV)    Short Circuit : LV    Temperature [°C] : 31.45 °C****Measurement****Cooling Type : ONAF [30 MVA]    Combination Name : HV (88 kV)/LV**

Tap Position	1	8	15						
Measured Impedance voltage [ Vm ]	[V]	7472.50	7295.80	6064.80					
Corrected Impedance Voltage at Rated Current	[V]	9604.42	8106.31	7038.37					
Applied Current [ ISc ]	A	138.59	177.15	189.50					
Rated Current [ IHR ]	A	178.13	196.83	219.92					
Measured Load Loss [ LLM ]	[W]	66170.00	88150.00	95280.00					
Corrected Load Loss At Rated Current [ LLC ]	[W]	109312.92	108823.47	128325.44					

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Strong relationships**Date :** 25/06/2015 **W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**MEASUREMENT OF LOAD LOSS AND IMPEDANCE VOLTAGE****Cooling Type :** ONAF [30 MVA]**Combination Name :** HV (88 kV)/LV

Tap Position	1	8	15						
Rated Current [ IHR ] [HV] A	178.13	196.83	219.92						
Rated Current [ ILR ] [LV] A	1574.64	1574.64	1574.64						
Avg. Resistance [ RhAvg ] [HV] at 41.2 °C Ohms	0.479460	0.416047	0.478307						
Avg. Resistance [ RIAvg ] [LV] at 41.2 °C Ohms	0.0059933	0.0059933	0.0059933						
Copper Loss[I <sup>2</sup> R] [ CLh ] [HV] at 41.2 °C [W]	45640.22	48355.54	69399.68						
Copper Loss[I <sup>2</sup> R] [ CLI ] [LV] at 41.2 °C [W]	44581.00	44581.00	44581.00						
Total Loss[I <sup>2</sup> R] at 41.2 °C [W]	90221.22	92936.54	113980.68						
Total Loss[I <sup>2</sup> R] [TCL] at 31.45 °C [W]	87020.03	89639.01	109936.47						
Corrected Load Loss [ LLC ] at 31.45 °C [W]	109312.92	108823.47	128325.44						
Stray Loss [SL =LLC - TCL] at 31.45 °C [W]	22292.89	19184.46	18388.97						
% Z at 31.45 °C %	9.88	9.23	8.97						
% R at 31.45 °C %	364.38	362.74	427.75						
% X at 31.45 °C %	364.25	362.62	427.66						
Total Copper Loss[I <sup>2</sup> R] at 75 °C [W]	101262.05	104309.66	127929.08						
Stray Loss at 75 °C [W] At Test Freq	19157.50	16486.26	15802.65						
Stray Loss at 75 °C [W] @ 50 Hz	19188.19	16565.68	15923.44						
Load Loss at 75 °C [W] At Test Freq	120419.55	120795.92	143731.73						
Load Loss at [30 KVA] at 75 °C [W] @ 50 Hz	120450.24	120875.34	143852.52						
% X at 75 °C %	364.25	362.62	427.66						
% R at 75 °C %	401.40	402.65	479.11						
% Z at [30 KVA] at 50 Hz at 75 °C %	542.03	541.87	642.21						

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**Date :** 27/07/2015    **W.O.No :** ET10335    **Serial No :** ET10335/1A  
**MVA :** 30    **Customer :** ZETDC

**APPLIED VOLTAGE TEST**

Winding's Under Test	*Ur[kV]	Test volt [kV]	Test Time(Sec)	Freq.[Hz]	Remarks
HV wdg to other wdg and Tank	132	38	60	50	WITHSTOOD OK
HV wdg to other wdg and Tank	88	38	60	50	WITHSTOOD OK
LV wdg to other wdg and Tank	11	38	60	50	WITHSTOOD OK

**\*Ur: Rated Line Voltage**

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Magnetic Balance & Excitation Current for Tap 8 From HV(88 kV) Side.				
Applied Voltage □	1U1 - N [V]	1V1 - N [V]	1W1 - N [V]	Current ( mA )
1U1 - N	244.4	220.4	23.2	4.53
1V1 - N	123.5	244.1	120.5	3.15
1W1 - N	18.92	225.2	244.3	4.58

Magnetic Balance & Excitation Current From LV Side.				
Applied Voltage □	2U1 - N [V]	2V1 - N [V]	2W1 - N [V]	Current ( mA )
2U1 - N	244.8	188.9	55.4	171.40
2V1 - N	122.8	244.9	121.7	122.50
2W1 - N	55.4	188.8	244.7	170.70

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**Date :** 29/07/2015    **W.O.No :** ET10335    **Serial No :** ET10335/1A  
**MVA :** 30    **Customer :** ZETDC

**MAGNETIC BALANCE AND EXCITATION CURRENT**

Magnetic Balance & Excitation Current for Tap 8 From HV(132 kV) Side.				
Applied Voltage □	1U1 - N [V]	1V1 - N [V]	1W1 - N [V]	Current ( mA )
1U1 - N	234.2	231.7	10.76	2.47
1V1 - N	121.1	234.4	113.1	1.74
1W1 - N	9.68	228.4	234.6	2.38

Magnetic Balance & Excitation Current From LV Side.				
Applied Voltage □	2U1 - N [V]	2V1 - N [V]	2W1 - N [V]	Current ( mA )
2U1 - N	233.6	184.7	47.4	171.40
2V1 - N	117	232.6	116.5	122.50
2W1 - N	47.8	184	234.2	170.70

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**Date :** 05/06/2015    **W.O.No :** ET10335    **Serial No :** ET10335/1A  
**MVA :** 30    **Customer :** ZETDC

**MEASUREMENT OF POWER TAKEN BY COOLER CIRCUIT**

<b>Average voltage L-L</b>	<b>412.5 V</b>
<b>Total Current</b>	<b>4.11 A</b>
<b>Measured Loss</b>	<b>2.91 kW</b>
<b>Guaranteed Loss</b>	<b>3 kW</b>

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**Date :** 24/06/2015    **W.O.No :** ET10335    **Serial No :** ET10335/1A  
**MVA :** 30    **Customer :** ZETDC

**OIL LEAKAGE TEST**

- Transformer was subjected to oil leakage test at pressure of 12 PSI measured at bottom of tank. The pressure was sustained for a period of 12 hours and observations were made. No drop in pressure or no leaks observed during the sustained period.

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Strong relationships**Date :** 24/06/2015**W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**MEASUREMENT OF ACOUSTIC NOISE LEVEL****Noise level measured in accordance with specification :****NEMA-TR1****Test Conditions****Excitation voltage[kV]** : 132**Tap position** : 8**Test Frequency[Hz]** : 50**Guaranteed Noise Level [dB]** : 76**Transformer Energised at Rated Voltage**

Point No	Before Energising Transformer Ambient (dB)		Cooling	
	1/3 rd Height	2/3 rd Height	ONAF (dB)	
			1/3 rd Height	2/3 rd Height
1	67.20	67.50	74.30	73.60
2			74.90	73.80
3			74.80	73.90
4	67.10	67.30	75.60	74.40
5			75	76.60
6			75.40	75.70
7	67	67	76	75.80
8			75.40	76.10
9			76.20	74.20
10	67.20	67.20	74.60	73.80
11			73.80	72.70
12			74.20	74
13			73.80	74.20
14	67.30	67.10	76.30	73
15			73.80	73.60
16			73.90	74.20
17			74.80	72.60

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Strong relationships**Date :** 24/06/2015**W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :**30**Customer :** ZETDC**MEASUREMENT OF ACOUSTIC NOISE LEVEL**

<b>Transformer Energised at Rated Voltage</b>				
<b>Point No</b>	<b>Before Energising Transformer Ambient (dB)</b>		<b>Cooling</b>	
	<b>1/3 rd Height</b>	<b>2/3 rd Height</b>	<b>ONAF (dB)</b>	
			<b>1/3 rd Height</b>	<b>2/3 rd Height</b>
18			74.60	75.40
19	67.40	67.10		
<b>Mean:-</b>	<b>67.20</b>	<b>67.20</b>	<b>74.93</b>	<b>74.46</b>
<b>Mean Avg:-</b>	<b>67.20</b>		<b>74.70</b>	

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Strong relationships**Date :** 24/06/2015**W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**LIGHTNING IMPULSE VOLTAGE WITHSTAND TEST**

Rated Voltage	Test Voltage [kVp]			Standard Waveform	Polarity
[kV]	FW	-	-	T1/T2/Tc	
132	650	-	-	[1.2 ± 0.36 / 50 ± 10/2-6] μS	[-] Negative

<b>Phase Applied</b>	Phase - 1U1	Phase - 1V1	Phase - 1W1
<b>Terminal</b>	HV(132) - 1U1	HV(132) - 1V1	HV(132) - 1W1
<b>Tap Position</b>	1	8	15
<b>WaveShape</b>	1.17 / 55.74 / NA μs	1.32 / 47.30 / NA μs	1.27 / 47.45 / NA μs

Test Sequence	Wave No.	Voltage		Wave No.	Voltage		Wave No.	Voltage	
		[%]	[kVp]		[%]	[kVp]		[%]	[kVp]
RFW	1	61.60	400.40	1	61.88	402.2	1	61.75	401.4
FW	2	100.00	650	2	100.42	652.7	2	100.12	650.8
FW	3	100.03	650.2	3	100.00	650	3	101.35	658.8
FW	4	100.18	651.2	4	99.97	649.8	4	99.29	645.4

**RFW : Reduced Full Wave / FW : Full Wave / RCW : Reduced Chopped Wave / CW : Chopped Wave****Result : Transformer withstood the Test Satisfactory.****WITNESSED BY****TESTED BY****APPROVED BY**



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Strong relationships**Date :** 24/06/2015**W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**LIGHTNING IMPULSE VOLTAGE WITHSTAND TEST**

Rated Voltage	Test Voltage [kVp]			Standard Waveform	Polarity
[kV]	FW	-	-	T1/T2/Tc	
11	95	-	-	[1.2 ± 0.36 / 50 ± 10/2-6] μS	[-] Negative
<b>Phase Applied</b>	Phase - 2U1			Phase - 2V1	Phase - 2W1
<b>Terminal</b>	LV - 2U1			LV - 2V1	LV - 2W1
<b>Tap Position</b>	-			-	-
<b>WaveShape</b>	1.28 / 42.56 / NA μs			1.28 / 42.93 / NA μs	1.29 / 42.70 / NA μs

Test Sequence	Wave No.	Voltage		Wave No.	Voltage		Wave No.	Voltage	
		[%]	[kVp]		[%]	[kVp]		[%]	[kVp]
RFW	1	53.09	50.44	1	52.11	49.5	1	52.00	49.4
FW	2	100.53	95.5	2	101.37	96.3	2	101.16	96.1
FW	3	100.11	95.1	3	99.79	94.8	3	99.89	94.9
FW	4	99.89	94.9	4	100.00	95.	4	100.11	95.1

**RFW : Reduced Full Wave / FW : Full Wave / RCW : Reduced Chopped Wave / CW : Chopped Wave****Result : Transformer withstood the Test Satisfactory.****WITNESSED BY****TESTED BY****APPROVED BY**



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Rated Voltage	Test Voltage [kVp]			Standard Waveform	Polarity
[kV]	FW	CW	-	T1/T2/Tc	
132	950	950	-	[1.2 ± 0.36 / 50 ± 10/2-6] μS	[-] Negative
<b>Phase Applied</b>	Phase - 1U1			Phase - 1V1	Phase - 1W1
<b>Terminal</b>	HV(132) - 1U1			HV(132) - 1V1	HV(132) - 1W1
<b>Tap Position</b>	1			8	15
<b>WaveShape</b>	1.17 / 55.74 / NA μs			1.32 / 47.30 / NA μs	1.27 / 47.45 / NA μs

Test Sequence	Wave No.	Voltage		Wave No.	Voltage		Wave No.	Voltage	
		[%]	[kVp]		[%]	[kVp]		[%]	[kVp]
RFW	1	42.15	400.40	1	42.34	402.2	1	42.25	401.4
FW	2	68.42	650.0	2	68.71	652.7	2	68.51	650.8
RCW	3	67.53	641.50	3	67.61	642.3	3	67.45	640.8
FCW	4	109.98	1044.8	4	109.92	1044.2	4	109.56	1040.8
FCW	5	109.60	1041.2	5	109.72	1042.3	5	109.65	1041.7
FW	6	68.44	650.2	6	68.42	650.0	6	69.35	658.8
FW	7	68.55	651.2	7	68.40	649.8	7	67.94	645.4

**RFW : Reduced Full Wave / FW : Full Wave / RCW : Reduced Chopped Wave / CW : Chopped Wave****Result : Transformer withstood the Test Satisfactory.****WITNESSED BY****TESTED BY****APPROVED BY**





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Strong relationships**Date :** 24/06/2015**W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**LIGHTNING IMPULSE VOLTAGE WITHSTAND TEST**

Rated Voltage	Test Voltage [kVp]			Standard Waveform	Polarity
[kV]	FW	CW	-	T1/T2/Tc	
11	95	95	-	[1.2 ± 0.36 / 50 ± 10/2-6] μS	[-] Negative
<b>Phase Applied</b>	Phase - 2U1			Phase - 2V1	Phase - 2W1
<b>Terminal</b>	LV - 2U1			LV - 2V1	LV - 2W1
<b>Tap Position</b>	-			-	-
<b>WaveShape</b>	1.28 / 42.56 / NA μs			1.28 / 42.93 / NA μs	1.29 / 42.70 / NA μs

Test Sequence	Wave No.	Voltage		Wave No.	Voltage		Wave No.	Voltage	
		[%]	[kVp]		[%]	[kVp]		[%]	[kVp]
RFW	1	53.09	50.44	1	52.11	49.5	1	52.00	49.4
FW	2	100.53	95.5	2	101.37	96.3	2	101.16	96.1
RCW	3	66.11	62.80	3	64.95	61.7	3	66.42	63.1
FCW	4	107.79	102.4	4	108.53	103.1	4	108.84	103.4
FCW	5	107.16	101.8	5	108.21	102.8	5	108.11	102.7
FW	6	100.11	95.1	6	99.79	94.8	6	99.89	94.9
FW	7	99.89	94.9	7	100.00	95.0	7	100.11	95.1

**RFW : Reduced Full Wave / FW : Full Wave / RCW : Reduced Chopped Wave / CW : Chopped Wave****Result : Transformer withstood the Test Satisfactory.****WITNESSED BY****TESTED BY****APPROVED BY**



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**Date :** 26/06/2015    **W.O.No :** ET10335    **Serial No :** ET10335/1A  
**MVA :** 30    **Customer :** ZETDC

**LIGHTNING IMPULSE VOLTAGE WITHSTAND TEST ON NEUTRAL TERMINAL**

<b>Winding</b>	HV-N
<b>Test Circuit</b>	Neutral
<b>Impulse On</b>	Neutral (N)
<b>Tap Position</b>	
<b>Wave Shape</b>	μs
<b>Test Voltage</b>	250
<b>Standard Waveform</b>	[1.2 ± 0.36 / 50 ± 10] μS
<b>Polarity</b>	[-] Negative

Test Sequence	Wave No.	Voltage	
		[%]	[kVp]
RFW	1	64.28	160.7
FW	2	99.12	247.8
FW	3	100.36	250.9
FW	4	99.92	249.8

**RFW : Reduced Full Wave / FW : Full Wave**

**Result : Transformer withstood the Test Satisfactory.**

<b>WITNESSED BY</b>	<b>TESTED BY</b>	<b>APPROVED BY</b>





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Rated Voltage	Test Voltage [kVp]			Waveform	Polarity
[kV]	-	-	SI	Tp/Td/Tz	
132	-	-	750	[ $\geq 100/\geq 200/\geq 1000 \mu\text{S}$ ]	[-] Negative

Phase Applied	Phase - 1U1			Phase - 1V1			Phase - 1W1		
Terminal	HV(132) - 1U1			HV(132) - 1V1			HV(132) - 1W1		
Tap Position	11			11			11		
WaveShape	259.20 / 208.10 / >1000 $\mu\text{S}$			255.60 / 204.20 / >1000 $\mu\text{S}$			257.10 / 206.80 / >1000 $\mu\text{S}$		
Test Sequence	Wave No.	Voltage		Wave No.	Voltage		Wave No.	Voltage	
		[%]	[kVp]		[%]	[kVp]		[%]	[kVp]
RFW	1	66.81	501.1	1	67.76	508.2	1	67.41	505.6
FW	2	100.83	756.2	2	101.09	758.2	2	100.81	756.1
FW	3	100.68	755.1	3	101.35	760.1	3	101.04	757.8
FW	4	100.32	752.4	4	100.55	754.1	4	101.21	759.1

**RFW : Reduced Full Wave / FW : Full Wave****Result : Transformer withstood the Test Satisfactory.****WITNESSED BY****TESTED BY****APPROVED BY**



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Strong relationships**Date :** 26/06/2015**W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**MEASUREMENT OF CAPACITANCE AND DISSIPATION FACTOR****For Bushing****Top Oil Temp. : 42.4°C | Bottom Oil Temp. : 39.6°C | Avg. Oil Temp. : 41°C**

Terminal Connected	Make / Sr. No.	Test voltage [kV]	Capacitance [pF]	Tan Delta in % @
				41 °C
HV	HSP/EA20140040 4.1	10.00	255.570	0.366
HV	HSP/EA20140040 5.1	10.00	253.840	0.376
HV	HSP/EA20140040 6.1	10.00	250.260	0.375

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CGL/T1/TTR/ET10335/1A

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NABL NO.T1620Smart solutions.  
Strong relationships**Date** : 26/06/2015**W.O.No** : ET10335**Serial No** : ET10335/1A**MVA** :30**Customer** : ZETDC**MEASUREMENT OF CAPACITANCE AND DISSIPATION FACTOR****For Winding/HV(132)**

Top Oil Temp. : 42.4°C		Bottom Oil Temp. : 39.6°C		Avg. Oil Temp. : 41°C	
Measured Between	Test Voltage [kV]	Capacitance pF	Tan Delta in % @		
			41 °C	20 °C	
HV/LV + E	10.00	7035.840	0.375	0.236	
LV/HV + E	10.00	11593.850	0.567	0.357	
HV/LV + g	10.00	3359.070	0.381	0.240	
LV/HV + g	10.00	7909.200	0.615	0.387	
HV/LV	10.00	3674.470	0.376	0.236	

**For Winding/HV(88)**

Top Oil Temp. : 42.4°C		Bottom Oil Temp. : 39.6°C		Avg. Oil Temp. : 41°C	
Measured Between	Test Voltage [kV]	Capacitance pF	Tan Delta in % @		
			41 °C	20 °C	
HV/LV + E	10.00	7047.260	0.321	0.202	
LV/HV + E	10.00	11595.810	373.000	234.591	
HV/LV + g	10.00	3361.410	0.322	0.203	
LV/HV + g	10.00	7904.290	0.391	0.246	
HV/LV	10.00	3684.290	0.329	0.207	

tan delta @ 20°C= Tan Delta @ Test Temp./ K, where K =0.6428 X e (0.0222x Avg. Temp.)

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CGL/T1/TTR/ET10335/1A

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NABL NO.T1620**TEST CERTIFICATE**  
**Prolific Systems And technology ltd**  
**Transformer (T1) Division**Smart solutions.  
Strong relationships**Date :** 26/06/2015**W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**INDUCED OVER VOLTAGE WITHSTAND TEST WITH PARTIAL DISCHARGE MEASUREMENT****IVPD****Ur = 132 kV****Calibration Signal :****Test Frequency : 1 Hz****All partial discharge measurements are in pC**

Test Volt. [kV]	Time in Mins		1U1	1V1	1W1
91.450	A	1	50	49	51
120.420	B	5	52	50	53
137.180	C	30 Sec	OK	OK	OK
120.420	D	5	51	52	55
120.420	D	10	53	54	54
120.420	D	15	52	55	54
120.420	D	20	54	55	56
120.420	D	25	53	54	57
120.420	D	30	55	54	56
120.420	D	35	54	55	56
120.420	D	40	532	56	54
120.420	D	45	55	56	54
120.420	D	50	54	57	55
120.420	D	55	55	55	53
120.420	D	60	53	56	52
91.450	E	1	52	51	52

	Background PD Level
Before Test	30.485
After Test	30.485
Guranteed Values	18
Background PD Level	16

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CGL/T1/TTR/ET10335/1A



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**Date :** 26/06/2015

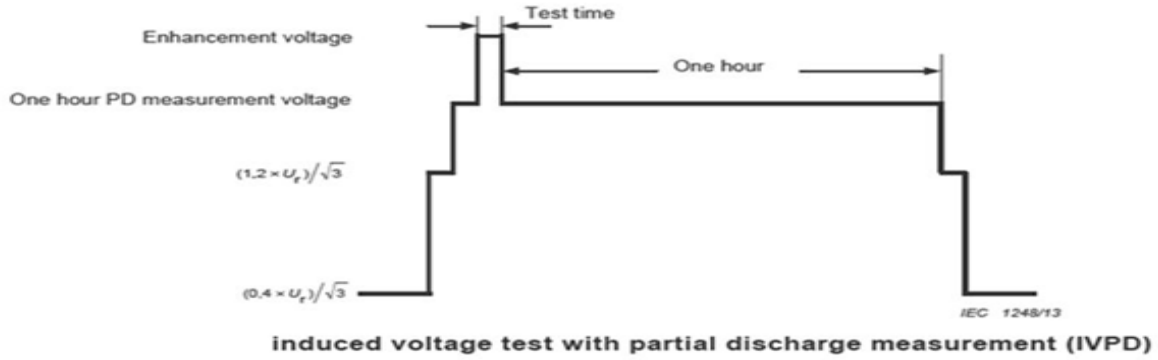
**W.O.No :** ET10335

**Serial No :** ET10335/1A

**MVA :** 30

**Customer :** ZETDC

## INDUCED OVER VOLTAGE WITHSTAND TEST WITH PARTIAL DISCHARGE MEASUREMENT



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**Date :** 15/07/2015    **W.O.No :** ET10335    **Serial No :** ET10335/1A  
**MVA :** 30    **Customer :** ZETDC

**CHECK OF CT RATIO AND POLARITY**

All Bushing CT's Checked for Ratio & Polarity AS PER r & d PLATE DRAWING T0225552VFGHTC

Found to be OK

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CGL/T1/TTR/ET10335/1A

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**Date :** 26/06/2015    **W.O.No :** ET10335    **Serial No :** ET10335/1A  
**MVA :** 30    **Customer :** ZETDC

**SFRA MEASUREMENT**

**SFRA for Winding : LV**

**TEST OBJECT** : 3P2WDualHV  
**VOLTAGE CLASS** : -  
**W.O. No.** : ET10335  
**SERIAL No.** : ET10335/1A  
**CUSTOMER** : ZETDC  
**TEST DATE** : 26/06/2015  
**TIME OF TEST** : Pre - Dispatch  
**TESTED AT** : Transformer (T1) Division

**Transformer Condition under Test**

- a) Transformer was fully filled with Oil
- b) Transformer tap switch kept at Normal position.
- c) Transformer fitted with bushings.

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CGL/T1/TTR/ET10335/1A



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**Date :** 26/06/2015    **W.O.No :** ET10335    **Serial No :** ET10335/1A  
**MVA :** 30    **Customer :** ZETDC

**SFRA MEASUREMENT****Test Connections**

Trace No	Red Lead position	Black Lead Position	Other Terminal Condition
1	1U1	1N	OPEN
2	1V1	1N	OPEN
3	1W1	1N	OPEN
4	1U1	1N	LV SHORTED
5	1V1	1N	LV SHORTED
6	1W1	1N	LV SHORTED
7	2U1	2N	OPEN
8	2V1	2N	OPEN
9	2W1	2N	OPEN

**Test Procedure for Winding : LV**

- 1) The transformer tested was completely isolated from the power supply.
- 2) In order to maintain consistency and repeatability of measurements, all terminals that are not under test were isolated and floating.
- 3) SFRA instrument was calibrated as per equipment operating manual.
- 4) Connections of the cables and Ground wire are followed as per the SFRA manual.

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CGL/T1/TTR/ET10335/1A

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NABL NO.T1620Smart solutions.  
Strong relationships**Date :** 27/06/2015**W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**TEMPERATURE RISE TEST**

<b>Measured no-load loss [kW] [Po]</b>	<b>:</b>	<b>24.246</b>
<b>Load loss [kW] [Pk] [at 75 °C]</b>	<b>:</b>	<b>143.850</b>
<b>Total losses to be fed [kW] [Po + Pk]</b>	<b>:</b>	<b>168.096</b>
<b>Supply side : HV</b>	<b>Short side : LV</b>	<b>Tap position : 15</b>
<b>Rated Current</b>	<b>:</b>	<b>141.097 A</b>
<b>Cooling</b>	<b>:</b>	<b>ONAF [30 MVA]</b>
<b>Yearly Average Ambient Temperature for Hot Spot calculation</b>	<b>:</b>	<b>20 °C</b>

Measurements				TEMPERATURES [°C]										
Hour	kW	kV	A	t1	t2	t3	t4	tAvg	I/L1	O/L1	I/L2	O/L2	ty	dtY
9:30	177.35	7.839	244.16	26.3	26.1	25.9	25.8	26.03	52.3	45.6	52.3	45.7	55.2	29.17
10:30	177.38	7.892	244.32	28.1	28.3	28.7	29.2	28.58	58.3	49.3	58.3	50.3	61.9	33.32
11:30	177.35	7.893	244.16	31.6	31.1	31.5	31.2	31.35	64.3	57.6	64.5	56.8	65.5	34.15
12:30	177.38	7.892	244.32	33.7	34.1	34.4	33.8	34.00	67.2	59.8	67.1	59.5	68.2	34.20
13:30	177.36	7.885	245.17	35.6	36.5	36.2	36.4	36.18	68.9	60.1	68.4	60.3	70.4	34.22
14:30	177.35	7.883	245.43	37.2	37.8	36.9	38.2	37.53	70.3	63.2	69.9	63.8	72.3	34.77
<b>Current reduced to rated current 141.097</b>														
15:30	177.38	7.882	245.22	37.9	38.2	37.1	38.5	37.93	69.8	61.2	69.7	61.5	71.2	33.27
<b>HV(88)/LV Winding ShutDown Phase 1</b>														

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CGL/T1/TTR/ET10335/1A

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NABL NO.T1620Smart solutions.  
Strong relationships**Date :** 27/06/2015**W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**TEMPERATURE RISE TEST**

Hour	TEMPERATURES [°C]			
	OTI	WTI-HV	WTI-LV	WTI--
9:30	56	63	64	64
10:30	60	69	70	70
11:30	66	74	74	74
12:30	68	76	78	78
13:30	70	80	78	78
14:30	72	82	80	80
<b>Current reduced to rated current 141.097</b>				
15:30	69.8	61.2	69.7	61.5
<b>HV(88)/LV Winding ShutDown Phase 1</b>				

t1.... t3/t4 : Ambient Temperature	I/L1...I/L2 : Cooler Inlet Temp.	ty : Top Oil Temperature
tAvg : Avg. Ambient Temp.	O/L1..O/L2 : Cooler Outlet Temp.	dty : Top Oil Temp. Rise
FO : Fibre Optics	OTI : Oil Temp. Indicator	WTI :Winding Temp. Indicator
W/I1...W/I2 : Water Inlet Temp.	W/O1...W/O2 : Water Outlet Temp.	CB : Cable Box
MB : Marshalling Box		

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Prolific Systems And technology ltd

Transformer (T1) Division

ISO/IEC 17025  
NABL NO.T1620Smart solutions.  
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Date : 27/06/2015

W.O.No : ET10335

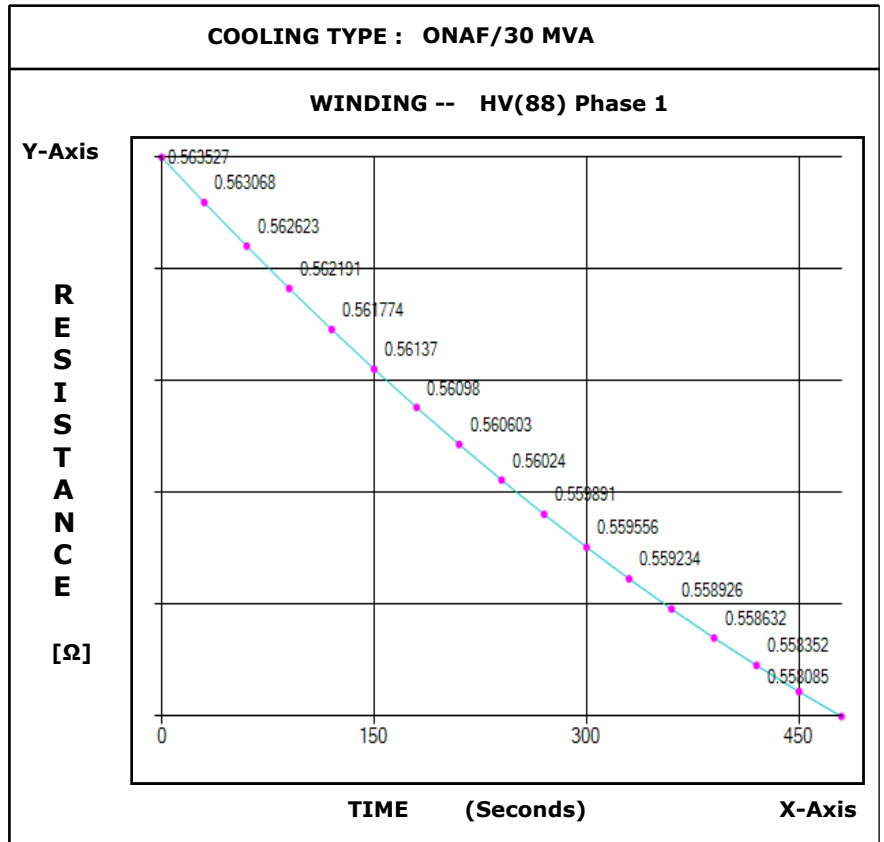
Serial No : ET10335/1A

MVA : 30

Customer : ZETDC

**TEMPERATURE RISE TEST****RESISTANCE - TIME CURVE**

Time [Sec]	HV(88) R[Ω]	Ext.Pol. R[Ω]
0		0.563527
30		0.563068
60		0.562623
90		0.562191
120		0.561774
150	0.5613639	0.561370
180	0.5609943	0.560980
210	0.5605963	0.560603
240	0.5602268	0.560240
270	0.5598856	0.559891
300	0.5595729	0.559556
330	0.5592886	0.559234
360	0.5588622	0.558926
390	0.5586348	0.558632
420	0.5583505	0.558352
450	0.5580947	0.558085
480	0.5578104	0.557832



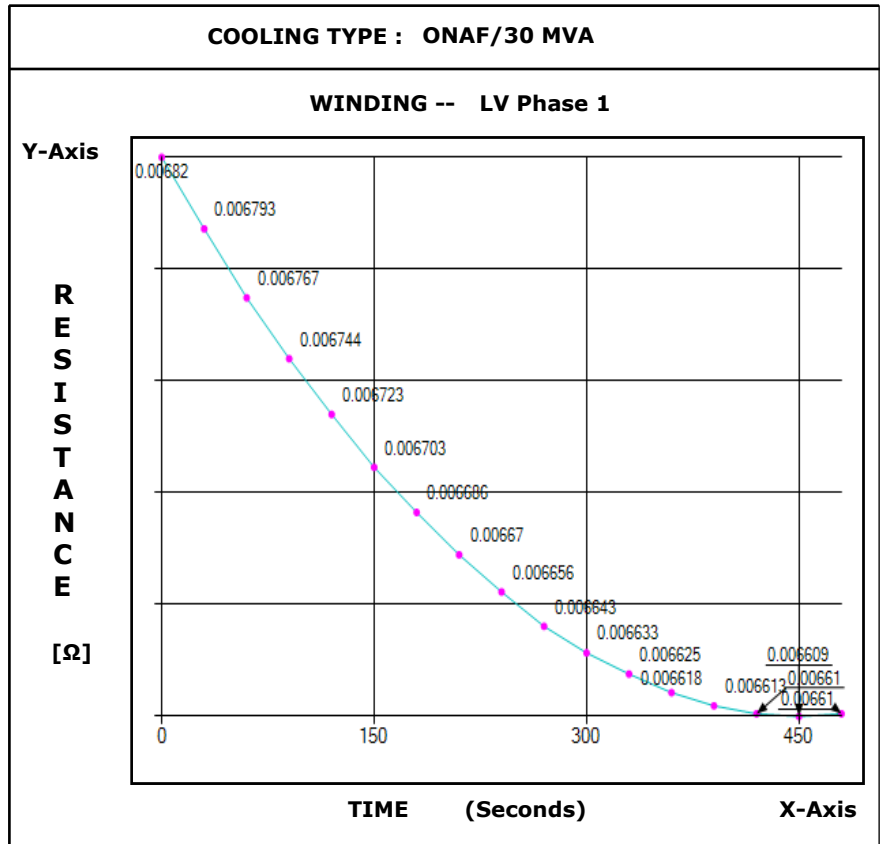
WITNESSED BY

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**TEST CERTIFICATE****Prolific Systems And technology ltd****Transformer (T1) Division**ISO/IEC 17025  
NABL NO.T1620Smart solutions.  
Strong relationships**Date :** 27/06/2015**W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**TEMPERATURE RISE TEST****RESISTANCE - TIME CURVE**

Time [Sec]	LV R[Ω]	Ext.Pol. R[Ω]
0		0.006820
30		0.006793
60		0.006767
90		0.006744
120		0.006723
150	0.0067087	0.006703
180	0.0066844	0.006686
210	0.0066658	0.006670
240	0.0066509	0.006656
270	0.0066398	0.006643
300	0.0066353	0.006633
330	0.0066285	0.006625
360	0.0066212	0.006618
390	0.0066162	0.006613
420	0.0066104	0.006610
450	0.0066051	0.006609
480	0.0066016	0.006610

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CGL/T1/TTR/ET10335/1A

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**Date :** 27/06/2015 **W.O.No :** ET10335

**Serial No :** ET10335/1A

**MVA :** 30

**Customer :** ZETDC

**TEMPERATURE RISE TEST**

<b>DETERMINATION OF TOP OIL TEMP. RISE</b>		HV(88)	LV
Reference Power	MVA	ONAF/30	ONAF/30
Total Losses Supplied	kW	177.35	177.35
Input Rated Losses to be fed	kW	168.096	168.096
Top Oil Temp. Rise at Supplied Losses	°C	34.77	34.77
Corrected Top Oil Temp. Rise to the Input Rated Loss	°C	34.77	34.77
Cooler Inlet Temp. [1st group]	°C	70.3	70.3
Cooler Inlet Temp. [2nd group]	°C	69.9	69.9
Average [Cooler Inlet Temp.]	°C	70.1	70.1
Cooler Outlet Temp.[1st group]	°C	63.2	63.2
Cooler Outlet Temp.[2nd group]	°C	63.8	63.8
Average [Cooler Outlet Temp.]	°C	63.5	63.5
Average Oil Rise at Steady State	°C	31.47	31.47
<b>DETERMINATION OF WINDING TEMP. RISE</b>		HV(88)	LV
Reference Power	MVA	ONAF/30	ONAF/30
Top Oil Temp. Rise @ Rated Current	°C	33.27	33.27
Cooler Inlet Temp. [1nd group]	°C	69.8	69.8
Cooler Inlet Temp. [2nd group]	°C	69.7	69.7
Average [Cooler Inlet Temp.]	°C	69.75	69.75
Cooler Outlet Temp. [1st group]	°C	61.2	61.2
Cooler Outlet Temp. [2nd group]	°C	61.5	61.5
Average [Cooler Outlet Temp.]	°C	61.35	61.35
Avg. Oil Rise at Shutdown	°C	29.07	29.07
Reference Cold Resistance at :41.2°C	Ohms	0.47756	0.00598
Winding Resis. at Shutdown From (Cooling Curve)	Ohms	0.563527	0.00682
Winding Temp. at Shutdown	°C	90.92	80.00
Average Ambient Temp. at Shutdown	°C	37.93	37.93
Gradiant	°C	23.92	13.00
Hot Spot Temp.	°C	85.87	71.67
<b>RESULTS</b>		HV(88)	LV
Top Oil Temp. Rise	°C	34.77	34.77
Winding Temp. Rise	°C	55.39	44.47
Hot Spot Temp.Rise	°C	65.866	51.67
<b>GUAR. VALUE</b>	Top Oil Temperature Rise	°C	60
	Mean Winding Temp. Rise	°C	65
	Hot spot tempeature Rise	°C	20

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CGL/T1/TTR/ET10335/1A

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NABL NO.T1620Smart solutions.  
Strong relationships**Date :** 27/06/2015**W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**TEMPERATURE RISE TEST**

<b>Measured no-load loss [kW] [Po]</b>	<b>:</b>	<b>24.246</b>
<b>Load loss [kW] [Pk] [at 75 °C]</b>	<b>:</b>	<b>63.933</b>
<b>Total losses to be fed [kW] [Po + Pk]</b>	<b>:</b>	<b>88.179</b>
<b>Supply side :</b> HV <b>Short side :</b> LV <b>Tap position :</b>		<b>15</b>
<b>Rated Current</b>	<b>:</b>	<b>94.064 A</b>
<b>Cooling</b>	<b>:</b>	<b>ONAN [20 MVA]</b>
<b>Yearly Average Ambient Temperature for Hot Spot calculation</b>	<b>:</b>	<b>20 °C</b>

Measurements				TEMPERATURES [°C]										
Hour	kW	kV	A	t1	t2	t3	t4	tAvg	I/L1	O/L1	I/L2	O/L2	ty	dty
1:00	94.53	5.760	178.84	25.8	26.2	26.3	26.2	26.13	41.0	28.3	41.1	28.9	41.3	15.17
2:00	94.52	5.772	178.86	24.7	24.7	24.5	24.3	24.55	49.5	35.3	49.8	35.7	50.2	25.65
3:00	94.53	5.759	178.88	24.5	24.3	24.2	24.1	24.28	51.3	39.5	51.2	39.1	52.5	28.22
4:00	94.55	5.762	178.85	23.8	24.2	23.7	24.1	23.95	52.2	41.2	52.5	41.4	53.1	29.15
5:00	94.52	5.761	178.89	23.5	23.9	23.5	24.0	23.73	52.6	43.5	52.9	43.7	53.5	29.77
6:00	94.56	5.762	178.91	23.1	23.5	23.2	23.7	23.38	52.9	44.2	53.5	44.3	53.8	30.42
7:00	94.53	5.763	178.88	22.8	23.1	22.9	23.3	23.03	53.2	45.0	53.8	45.1	54.2	31.17
<b>Current reduced to rated current 94.064</b>														
8:00	94.53	5.763	178.88	23.5	23.9	23.8	23.9	23.78	52.0	44.5	52.4	44.6	53.2	29.42
<b>HV(88)/LV Winding ShutDown Phase 2</b>														

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CGL/T1/TTR/ET10335/1A

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NABL NO.T1620Smart solutions.  
Strong relationships**Date :** 27/06/2015**W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**TEMPERATURE RISE TEST**

Hour	TEMPERATURES [°C]			
	OTI	WTI-HV	WTI-LV	WTI--
1:00	39.00	48.00	48.00	50.00
2:00	48.00	56.00	56.00	56.00
3:00	50.00	60.00	60.00	58.00
4:00	52.00	60.00	60.00	60.00
5:00	52.00	60.00	60.00	60.00
6:00	52.00	62.00	62.00	62.00
7:00	54.00	62.00	62.00	62.00
<b>Current reduced to rated current 94.064</b>				
8:00	50.00	58.00	58.00	58.00
<b>HV(88)/LV Winding ShutDown Phase 2</b>				

t1..... t3/t4 : Ambient Temperature	I/L1....I/L2 : Cooler Inlet Temp.	ty : Top Oil Temperature
tAvg : Avg. Ambient Temp.	O/L1..O/L2 : Cooler Outlet Temp.	dty : Top Oil Temp. Rise
FO : Fibre Optics	OTI : Oil Temp. Indicator	WTI :Winding Temp. Indicator
W/I1...W/I2 : Water Inlet Temp.	W/O1...W/O2 : Water Outlet Temp.	CB : Cable Box
MB : Marshalling Box		

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**TEST CERTIFICATE****Prolific Systems And technology ltd****Transformer (T1) Division**ISO/IEC 17025  
NABL NO.T1620Smart solutions.  
Strong relationships**Date :** 27/06/2015**W.O.No :** ET10335**Serial No :** ET10335/1A**MVA :** 30**Customer :** ZETDC**TEMPERATURE RISE TEST****RESISTANCE - TIME CURVE**

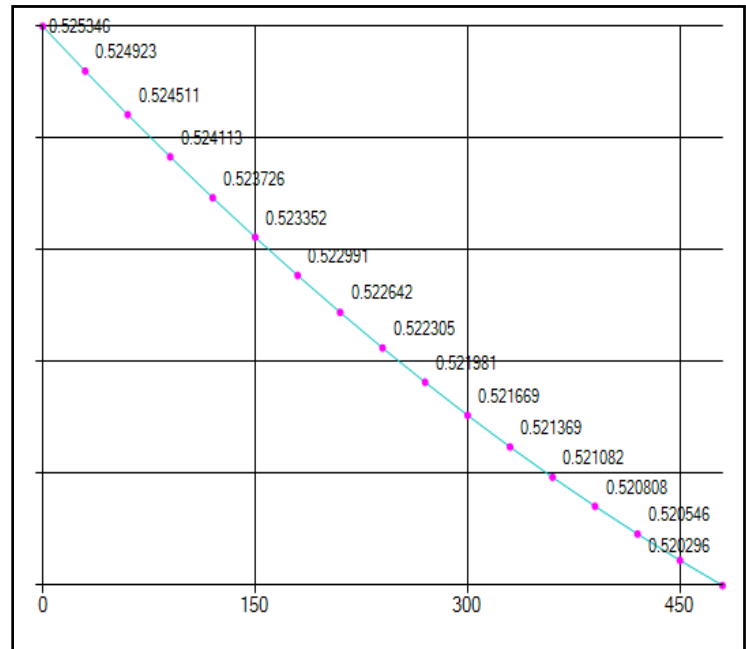
Time [Sec]	HV(88) R[Ω]	Ext.Pol. R[Ω]
0		0.525346
30		0.524923
60		0.524511
90		0.524113
120		0.523726
150	0.523343	0.523352
180	0.523012	0.522991
210	0.522625	0.522642
240	0.522293	0.522305
270	0.521989	0.521981
300	0.521686	0.521669
330	0.521409	0.521369
360	0.521023	0.521082
390	0.520802	0.520808
420	0.520553	0.520546
450	0.520304	0.520296
480	0.520028	0.520059

**COOLING TYPE : ONAN/20 MVA****WINDING -- HV(88) Phase 2**

Y-Axis

R  
E  
S  
I  
S  
T  
A  
N  
C  
E

[Ω]

**TIME (Seconds)****X-Axis****WITNESSED BY****TESTED BY****APPROVED BY**



# TEST CERTIFICATE

**Prolific Systems And technology ltd**

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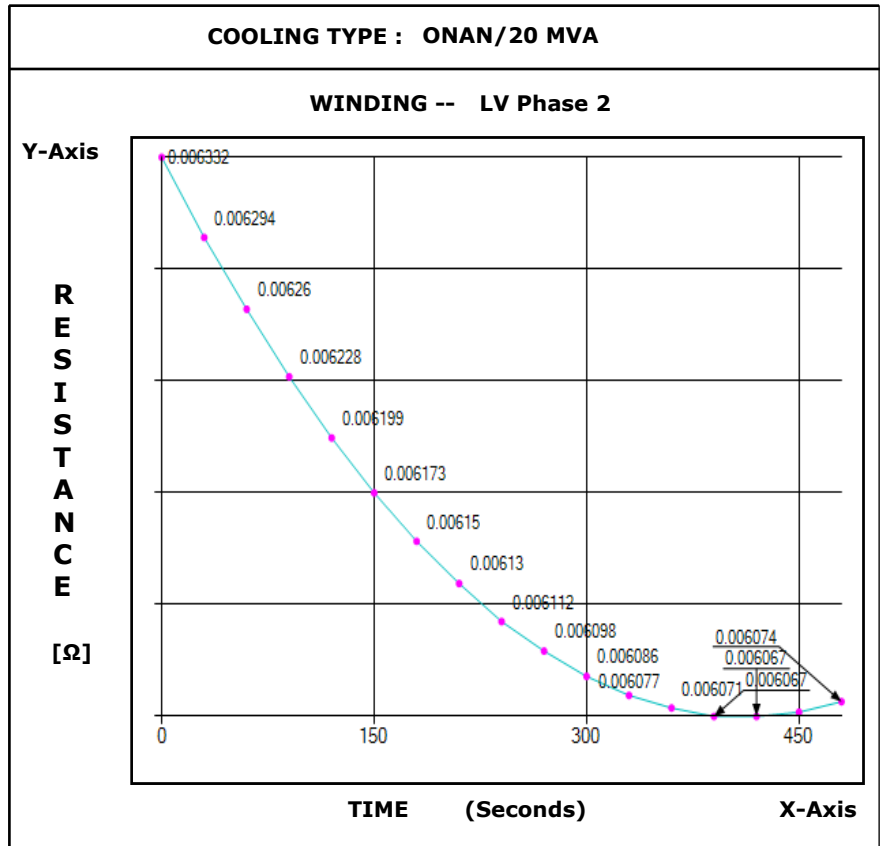
**Date :** 27/06/2015      **W.O.No :** ET10335      **Serial No :** ET10335/1A

**MVA :** 30      **Customer :** ZETDC

## TEMPERATURE RISE TEST

### RESISTANCE - TIME CURVE

Time [Sec]	LV R[Ω]	Ext.Pol. R[Ω]
0		0.006332
30		0.006294
60		0.006260
90		0.006228
120		0.006199
150	0.006178	0.006173
180	0.006161	0.006150
210	0.006115	0.006130
240	0.006102	0.006112
270	0.006094	0.006098
300	0.006090	0.006086
330	0.006083	0.006077
360	0.006077	0.006071
390	0.006072	0.006067
420	0.006067	0.006067
450	0.006062	0.006069
480	0.006057	0.006074



**WITNESSED BY**

**TESTED BY**

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ISO/IEC 17025  
NABL NO.T1620

CGL/T1/TTR/ET10335/1A

**TEST CERTIFICATE**  
**Prolific Systems And technology ltd**  
**Transformer (T1) Division**



Smart solutions.  
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**Date :** 27/06/2015 **W.O.No :** ET10335

**Serial No :** ET10335/1A

**MVA :** 30

**Customer :** ZETDC

**TEMPERATURE RISE TEST**

<b>DETERMINATION OF TOP OIL TEMP. RISE</b>		HV(88)	LV
Reference Power	MVA	ONAN/20	ONAN/20
Total Losses Supplied	kW	94.53	94.53
Input Rated Losses to be fed	kW	88.179	88.179
Top Oil Temp. Rise at Supplied Losses	°C	31.17	31.17
Corrected Top Oil Temp. Rise to the Input Rated Loss	°C	31.17	31.17
Cooler Inlet Temp. [1st group]	°C	53.2	53.2
Cooler Inlet Temp. [2nd group]	°C	53.8	53.8
Average [Cooler Inlet Temp.]	°C	53.5	53.5
Cooler Outlet Temp.[1st group]	°C	45.0	45.0
Cooler Outlet Temp.[2nd group]	°C	45.1	45.1
Average [Cooler Outlet Temp.]	°C	45.05	45.05
Average Oil Rise at Steady State	°C	26.95	26.95
<b>DETERMINATION OF WINDING TEMP. RISE</b>		HV(88)	LV
Reference Power	MVA	ONAN/20	ONAN/20
Top Oil Temp. Rise @ Rated Current	°C	29.42	29.42
Cooler Inlet Temp. [1nd group]	°C	52.0	52.0
Cooler Inlet Temp. [2nd group]	°C	52.4	52.4
Average [Cooler Inlet Temp.]	°C	52.2	52.2
Cooler Outlet Temp. [1st group]	°C	44.5	44.5
Cooler Outlet Temp. [2nd group]	°C	44.6	44.6
Average [Cooler Outlet Temp.]	°C	44.55	44.55
Avg. Oil Rise at Shutdown	°C	25.60	25.60
Reference Cold Resistance at :41.2°C	Ohms	0.47838	0.00598
Winding Resis. at Shutdown From (Cooling Curve)	Ohms	0.525346	0.006332
Winding Temp. at Shutdown	°C	68.32	57.46
Average Ambient Temp. at Shutdown	°C	23.78	23.78
Gradiant	°C	18.94	8.08
Hot Spot Temp.	°C	75.79	61.67
<b>RESULTS</b>		HV(88)	LV
Top Oil Temp. Rise	°C	31.17	31.17
Winding Temp. Rise	°C	45.89	35.03
Hot Spot Temp.Rise	°C	55.792	41.674
<b>GUAR. VALUE</b>	Top Oil Temperature Rise	°C	60
	Mean Winding Temp. Rise	°C	65
	Hot spot tempeature Rise	°C	20

<b>WITNESSED BY</b>	<b>TESTED BY</b>	<b>APPROVED BY</b>

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