ENERGOMONT
24415 Bački Vinogradi , Segedinski put 89 - Tel / fax:024 / 4757-013, 4757-093
office@energomont.rs www.energomont.rs

2025



Project document of three-phased oil transformer With OLTC tap changer

Type ECO2T_0400CH_223

ENERGOMONT
24415 Bački Vinogradi , Segedinski put 89 - Tel / fax:024 / 4757-013, 4757-093
office@energomont.rs www.energomont.rs

Contents:

Project document of three-phased oil transformer 2

- Basic technical data 2
- Comparison of calculated and measured values 3

Temmperature rise test 4

Project document of three-phased oil transformer

- **Basic technical data**

Basic datas			
Manufacturer		Energomont d.o.o.	
Type		ECO2T-400CH-223	
Design		Hermetic closed	
Standard		IEC 60076 / EU548/2014	
Electrical parameters			
Rated power	S_n	400	[kVA]
Nominal voltage in the middle position	U_1 / U_2	22±4x2,5% /0,42	[kV]
Maximum primary line voltage		24,2	[kV]
Rated current	I_1 / I_2	10,50 / 549,86	[A]
Frequency	F	50	[Hz]
No-load loss	P_0	≤ 425	[W]
Load loss (75°C)	P_k	≤ 3250	[W]
Short circuit voltage (75°C)	u_k	4,0 (± 10%)	[%]
Phase number		3	
Switch group		Dyn5	
Step switch operating under primary side load Level 1 corresponds to the highest voltage Level 5 correspond to the nominal voltage Level 9 corresponds to the lowest voltage	EN 6214	± 4 x 2,5	[%]
Primary insulation level	EN 60076-3	LI125 /AC50kV	[kV]
Secondary insulation level	EN 60076-3	LI20/ AC10kV	[kV]
Non electrical parameters			
Ambient temperature		-25 ÷ 40	[°C]
Permissible coil heating		65	[K]
Allowed oil heating		60	[K]
Material of coils		Cu/Cu	
Cooling mode		ONAN	
Permitted installation above sea level		≤ 1000	[m]
NF pass-through insulator		Porcelain bushing	DIN 42531
KF pass-through insulator		Porcelain bushing	EN 50386
Secondary side connector flag 4 pcs		Brass M20 -630A	DIN 43675
Placement		Outdoor	
Corrosion protection		RAL 7033 (C5)	
Grounding lugs 3 pcs		D=ø30,H=25,M12	EN 50216-4
Integrated protection (gas relay, contact thermometer, pressure sensor)		MCHD 2018-05 , or similiar	Optional
Oil drain plug		NW22	DIN 42551
Data plate			EN 60076-1

Thermometer pocket			DIN 42554
Mineral oil			EN 60296
Wheelbase		670 mm	EN 50216-4

- **Comparison of calculated and measured values**

			Calculated	Measured	
No-load losses	P_0	W	425	399	
No-load current	I_0	%	0.2	0.12	
Copper losses under load on 75°C	P_{k75}	W	3250	3221,45	
Short-circuit voltage on 75°C	u_{k75}	%	3.74	3.7	
Transformer vessel temperature related to the environment	$\Delta\theta_4$	°C	31.55	29.6	
Copper temperature	$\Delta\theta_{cu\text{-}amb}$	°C	49.8	Prim	Sek
				45.77	45.89
Oil temperature	$\Delta\theta_{umax\text{-}amb}$	°C	34.55	34.1	

ENERGOMONT
24415 Bački Vinogradi , Segedinski put 89 - Tel / fax:024 / 4757-013, 4757-093
office@energomont.rs www.energomont.rs

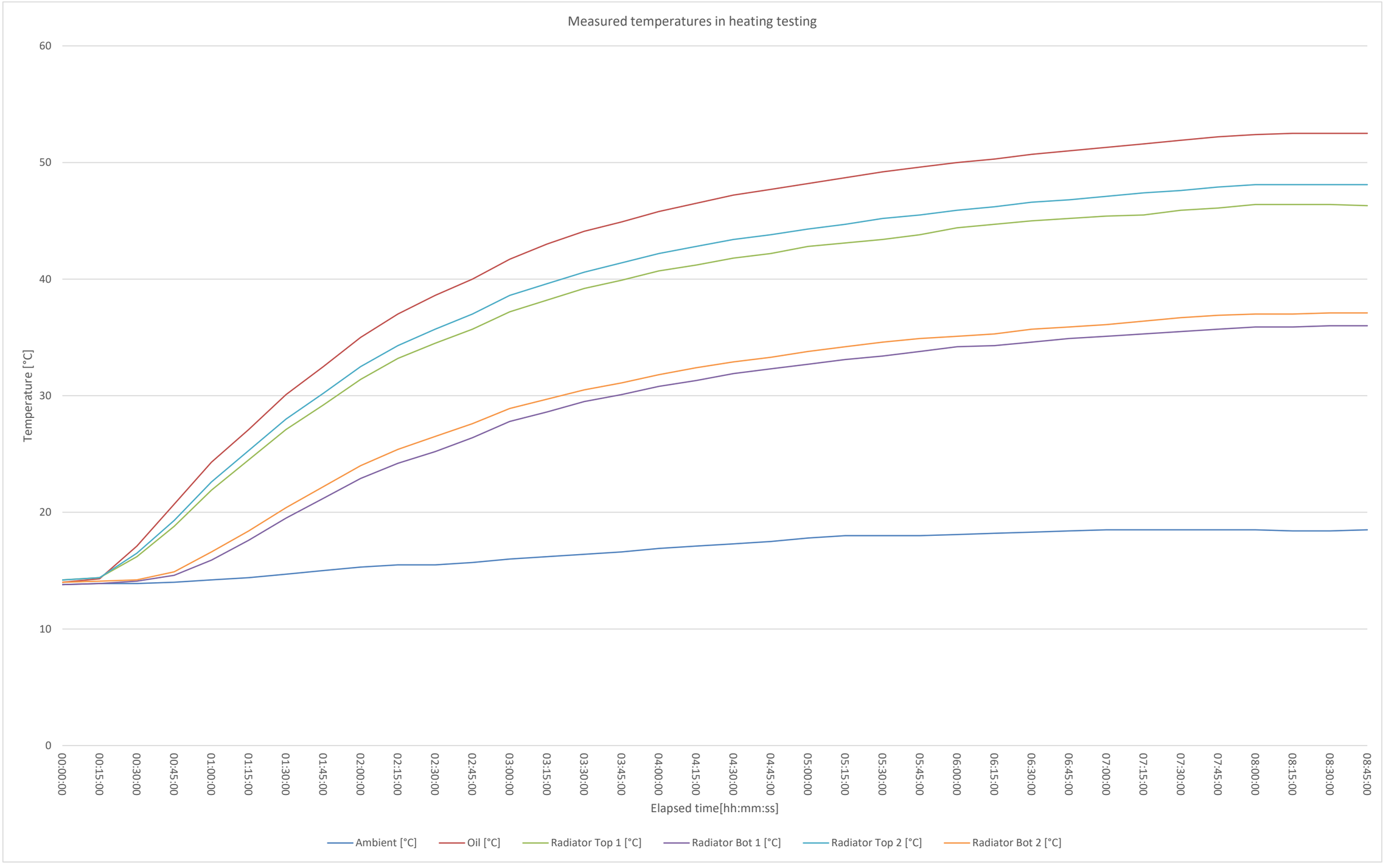
Temmperature rise test

Energomont doo	**Increasing temperature measuring**	Instructions:	
Bački Vinogradi		Number of type testing:	
		Sheet number (num. of sheets)	

Temperature measuring

Timer	Ambient	Oil	Radiator Top 1	Radiator Bottom1	Radiator Top 2	Radiator Bottom 2	Δθmax	
00:00:00	13,8	14	14,2	13,8	14,2	14		Pfor
00:30:00	13,9	17,1	16,2	14,1	16,5	14,2	3,2	
01:00:00	14,2	24,3	21,9	15,9	22,6	16,6	10,1	
01:30:00	14,7	30,1	27,1	19,5	28	20,4	15,4	
02:00:00	15,3	35	31,4	22,9	32,5	24	19,7	
02:30:00	15,5	38,6	34,5	25,2	35,7	26,5	23,1	
03:00:00	16	41,7	37,2	27,8	38,6	28,9	25,7	
03:30:00	16,4	44,1	39,2	29,5	40,6	30,5	27,7	
04:00:00	16,9	45,8	40,7	30,8	42,2	31,8	28,9	
04:30:00	17,3	47,2	41,8	31,9	43,4	32,9	29,9	Pcu75+Pfe
05:00:00	17,8	48,2	42,8	32,7	44,3	33,8	30,4	
05:30:00	18	49,2	43,4	33,4	45,2	34,6	31,2	
06:00:00	18,1	50	44,4	34,2	45,9	35,1	31,9	
06:30:00	18,3	50,7	45	34,6	46,6	35,7	32,4	
07:00:00	18,5	51,3	45,4	35,1	47,1	36,1	32,8	
07:30:00	18,5	51,9	45,9	35,5	47,6	36,7	33,4	
08:00:00	18,5	52,4	46,4	35,9	48,1	37	33,9	
08:30:00	18,4	52,5	46,4	36	48,1	37,1	**34,1**	In
08:45:00	18,5	52,5	46,3	36	48,1	37,1	34,0	

$\Delta\theta max = 34.1°C$



ENERGOMONT
24415 Bački Vinogradi , Segedinski put 89 - Tel / fax:024 / 4757-013, 4757-093
office@energomont.rs www.energomont.rs

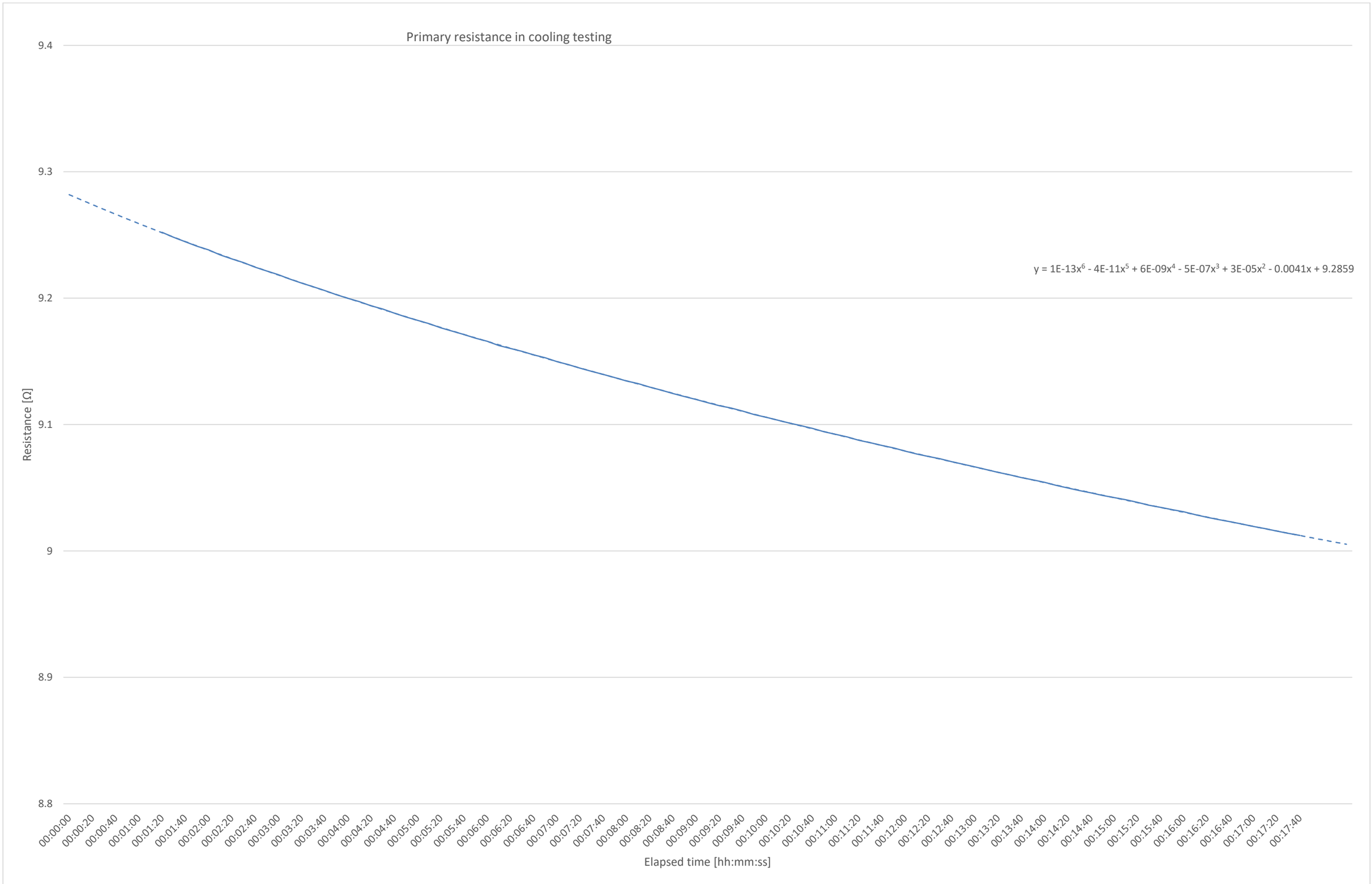
Cooling testing

Energomont doo	**Increasing temperature measuring**	Instructions:	
Bački Vinogradi		Number of type testing:	
		Sheet number (num. of sheets)	

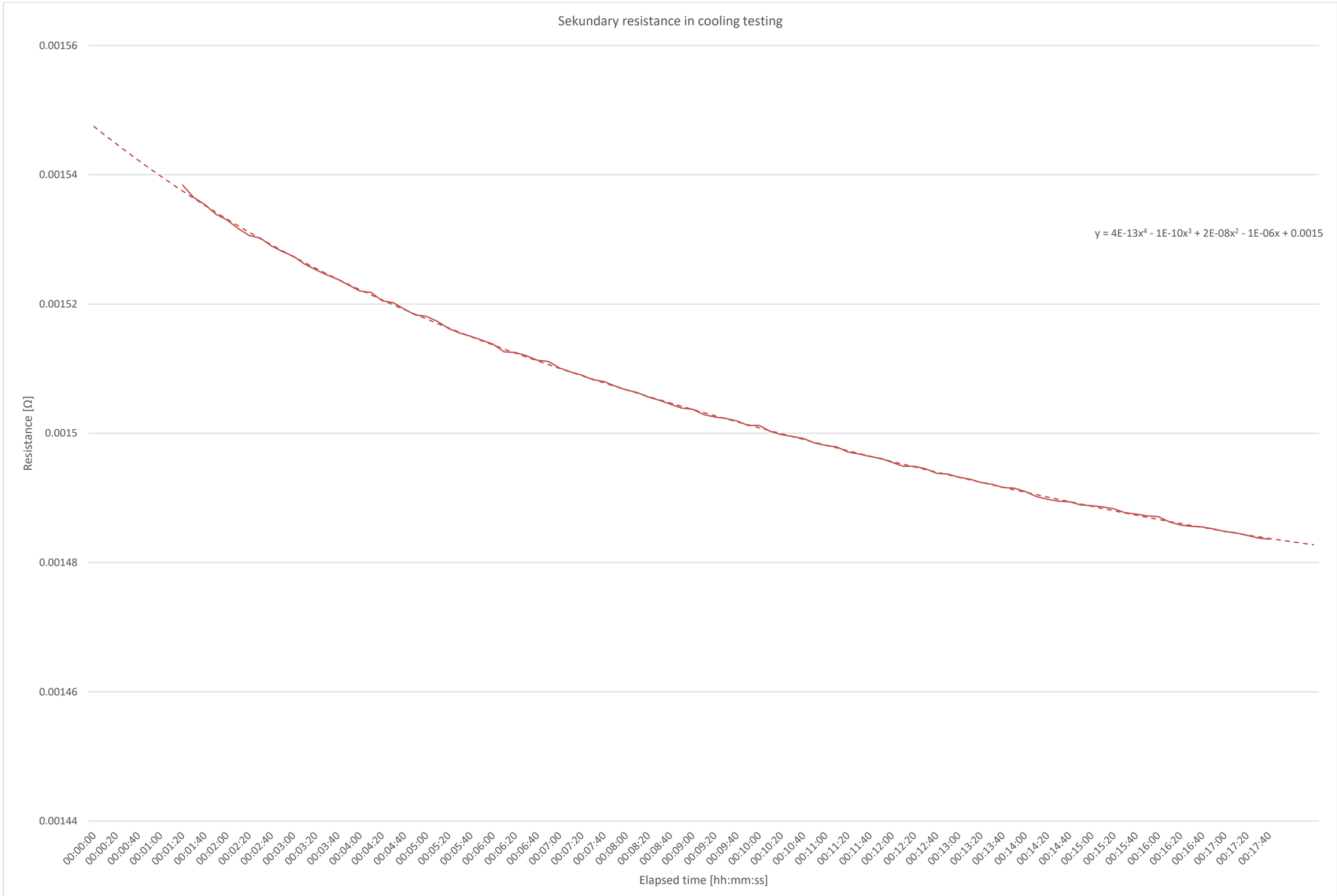
Resistance measuring of hot windings with analyser Tettex 2293 (SN: 181845)

Coil	Primary A-B		Sekundary a-0	
Time	R'[Ω]	ΔΘ'[°C]	R''[Ω]	ΔΘ''[°C]
00:00:00	9,283	45,77	0,0015455	45,89
00:00:30				
00:00:50				
00:01:20	9,2521	44,78	0,0015384	44,51
00:01:50	9,2412	44,43	0,0015339	43,64
00:02:20	9,2311	44,10	0,0015306	43,00
00:02:50	9,2216	43,79	0,0015281	42,52
00:03:20	9,212	43,48	0,0015253	41,98
00:03:50	9,2028	43,19	0,0015229	41,51
00:04:20	9,194	42,90	0,0015205	41,05
00:04:50	9,1852	42,62	0,0015183	40,62
00:05:20	9,1766	42,34	0,0015162	40,21
00:05:50	9,1684	42,08	0,0015144	39,86
00:06:20	9,1603	41,82	0,0015125	39,50
00:06:50	9,1529	41,58	0,0015111	39,22
00:07:20	9,1447	41,32	0,0015090	38,82
00:07:50	9,1372	41,07	0,0015073	38,49
00:08:20	9,1296	40,83	0,0015056	38,16
00:08:50	9,1222	40,59	0,0015039	37,83
00:09:20	9,1149	40,35	0,0015025	37,56
00:09:50	9,1079	40,13	0,0015012	37,31
00:10:20	9,1013	39,92	0,0014998	37,04
00:10:50	9,0943	39,69	0,0014985	36,78
00:11:20	9,0876	39,47	0,0014971	36,51
00:11:50	9,0815	39,28	0,0014961	36,32
00:12:20	9,0748	39,06	0,0014949	36,09
00:12:50	9,0686	38,86	0,0014937	35,85
00:13:20	9,0622	38,66	0,0014924	35,60
00:13:50	9,0563	38,47	0,0014915	35,43
00:14:20	9,0498	38,26	0,0014898	35,10
00:14:50	9,0439	38,07	0,0014889	34,92
00:15:20	9,0385	37,89	0,0014883	34,81
00:15:50	9,0327	37,70	0,0014872	34,59
00:16:20	9,0266	37,51	0,0014858	34,32
00:16:50	9,0213	37,34	0,0014852	34,21
00:17:20	9,0158	37,16	0,0014842	34,01
00:17:40	9,0123	37,05	0,0014836	33,90

ENERGOMONT
24415 Bački Vinogradi , Segedinski put 89 - Tel / fax:024 / 4757-013, 4757-093
office@energomont.rs www.energomont.rs



ENERGOMONT
24415 Bački Vinogradi , Segedinski put 89 - Tel / fax:024 / 4757-013, 4757-093
office@energomont.rs www.energomont.rs



Energomont doo	**Increasing temperature measuring**	Instructions:	
Bački Vinogradi		Number of type testing:	
		Sheet number (number of sheets)	4 (4)

CALCULATION

Temperature increasing of windings is determined by calculation based on winding resistance increasing which is gained by measuring the resistance in hot and cold condition.

INDEX

θ'o	-	Cold primar winding temperature at Rh	14,7°C
Rh	-	Cold primar winding resistance	7,7453Ω
Rt	-	Hot primar winding resistance	9,283Ω
θ"o	-	Cold sekundar winding temperature at Rh	14,7°C
rt	-	Hot sekundar winding resistance	0,1545mΩ
rh	-	Cold sekundar winding resistance	0,1289mΩ
Θam	-	Environment temperature	18,5°C
θ'n	-	Hot primar winding temperature at Rt	64.27°C
θ"n	-	Hot sekundar winding temperature at Rt	64.39°C
ΔΘ'n	-	Maximum temperature increase on primar	45.77°C
ΔΘ"n	-	Maximum temperature increase on sekundar	45.89°C

a) PRIMAR WINDING

$$\theta'n = \left(\frac{Rt}{Rh}\right) * (235 + \theta'o) - 235 = 64.27°C$$

$$\Delta\theta'n = \theta'n - \theta am = 45.77°C$$

b) SEKUNDAR WINDING

$$\theta''n = \left(\frac{rt}{rh}\right) * (235 + \theta'o) - 235 = 64.39°C$$

$$\Delta\theta''n = \theta''n - \theta am = 45.89°C$$

c) MAXIMUM TEMPERATURE INCREASE OF OIL

$$\Delta\theta max = 34.1°C$$

ENERGOMONT

TEST SHEET OF TRANSFORMERS CE

Form A-EOB 009

Manufacturer	Energomont d.o.o.		

Power transformer

Type	ECO2T 400 CH223			Year	2025			
Serial No.	8100			Connection	Dyn5			
Rated Power	400		kVA					
Rated voltage	1	24.200		V	Dielectric Liquid	Ásvány.O		
	2	23.650		V	Cooling	ONAN		
	3	23.100		V	No. of phases	3		
	4	22.550		V	Rated frequency	50	Hz	
	5	22.000	420	V	Short-circuit imp.	3,70	%	
	6	21.450		V	Mass of oil	310	kg	
	7	20.900		V	Mass of core and wdg.	1314	kg	
	8	20.350		V	Total mass	1884	kg	
	9	19.800		V				
Current		10,5	549,86	A				
Ins. Level		LI125 AC50	LI-- AC10					
Standard		IEC EN 60076-1						

Number of test sheet	8100 /2024
Standard assaying	IEC 60076-1, -2, -3

	Measured	Guaranteed
u_{k75} [%]	3,70	4,0 ± 0 %
P_{k75} [W]	3221,45	3250,0 + 0 %
P_0 [W]	399	425,0 + 0 %
∑P [W]	3620,45	3675,0 + 0 %
I_0 [%]	0,12	

☒ Buchholz relay ☐ Oil level indicator

Manufacturer:	IDEF SYSTEM
Type:	DMCR
Serial No.:	328538

Transmission ratio of Transformation

Measured values

Poz.	Phase AB / a-n	Dev. [%]	Phase BC / b-n	Dev. [%]	Phase CA / c-n	Dev. [%]
1	99,962	0,16	99,957	0,16	99,968	0,17
2	97,669	0,14	97,664	0,14	97,675	0,15
3	95,375	0,12	95,371	0,11	95,381	0,12
4	93,084	0,10	93,079	0,09	93,089	0,10
5	90,789	0,07	90,784	0,06	90,794	0,07
6	88,495	0,04	88,491	0,04	88,500	0,05
7	86,201	0,01	86,198	0,01	86,207	0,02
8	83,908	-0,02	83,904	-0,02	83,913	-0,01
9	81,615	-0,05	81,612	-0,05	81,620	-0,04

Winding resistance in [Ω] on 14,7 °C

Phase A-B	Phase B-C	Phase C-A
8,5144	8,5186	8,5195
8,3195	8,3243	8,3253
8,1265	8,1309	8,1326
7,9360	7,9395	7,9414
7,7453	7,7479	7,7504
7,5532	7,5568	7,5603
7,3644	7,3673	7,3714
7,1773	7,1793	7,1843
6,9896	6,9913	6,9967

Connection	Dyn5	Tettex 2293

[mΩ] a-n	[mΩ] b-n	[mΩ] c-n
1,2885	1,2851	1,3107

No-Load measuring

U [V]	I [A]		P_0 [W]
420	I_a	0,81	399
	I_b	0,57	
	I_c	0,47	
	I_{avg}	0,62	
	I_0 [%]	0,12	

Short circuit measuring

Phase	U [V]	I [A]	P [W]	u_{k75} [%]	P_{k75} [W]
A	779,82	10,14	2513	3,70	3221,45
B	781,12	10,16			
C	782,25	10,18			
avg	781,06	10,16			
Connected: A-B-C			Short connected: a-b-c		

Resistance of isolation

Between windings	R_{15} [GΩ]	R_{60} [GΩ]	R_{60} / R_{15}
HV - (LV+ 💡)	11,3	18,4	1,63
LV- (HV+ 💡)	9,20	19,5	2,12
HV-LV	12,9	23,9	1,85

Testing the tanδ of oil

Temperature [°C]	36
Test voltage [kV]	9,98
Value of tanδ [%]	+0,048
Diel.Liquid	Mol TO 40A IEC60296

The diel. strength of the Oil

Temperature [°C]	36
Measurement result [kV]	54,2
Standard	IEC 60156-95

Tested:	Bački Vinogradi	Approved by:
Ivan Kuzmanov el. eng.	16.01.2025.	Gabor Tilinko el. tech.

ENERGOMONT
24415 Bački Vinogradi , Segedinski put 89 - tel / fax:024 / 4757-013, 4757-093
office@energomont.rs www.energomont.rs

TEST SHEET OF TRANSFORMERS CE

Form A-EOB 009

Manufacturer	Energomont d.o.o.		

Power transformer

Type	ECO2T 400 CH223			Year	2025			
Serial No.	8100			Serial No.	Dyn5			
Rated Power	400		kVA					
Rated voltage	1	24.200		V	Dielectric Liquid	Ásvány.O		
	2	23.650		V	Cooling	ONAN		
	3	23.100		V	No. of phase	3		
	4	22.550		V	Rated frequency	50	Hz	
	5	22.000	420	V	Short-circuit imp.	3,70	%	
	6	21.450		V	Mass of oil	310	kg	
	7	20.900		V	Mass of core and wdg.	1314	kg	
	8	20.350		V	Total mass	1884	kg	
	9	19.800		V				
Current		10,5	549,86	A				
Ins. Level		LI125 AC50	LI-- AC10					
Standard		IEC EN 60076-1						

Number of test sheet	8100 /2024
Standard assaying	IEC 60076-1, -2, -3

	Measured	Guaranteed
u_{k75} [%]	3,70	4,0 ± 0 %
P_{k75} [W]	3221,45	3250,0 + 0 %
P_0 [W]	399	425,0 + 0 %
∑P [W]	3620,45	3675,0 + 0 %
I_0 [%]	0,12	

☒ Buchholz relay ☐ Oil level indicator

Manufacturer:	IDEF SYSTEM
Type:	DMCR
Serial No.:	328538

Testing the loss factor of the insulation windings (tanδ of the winding)

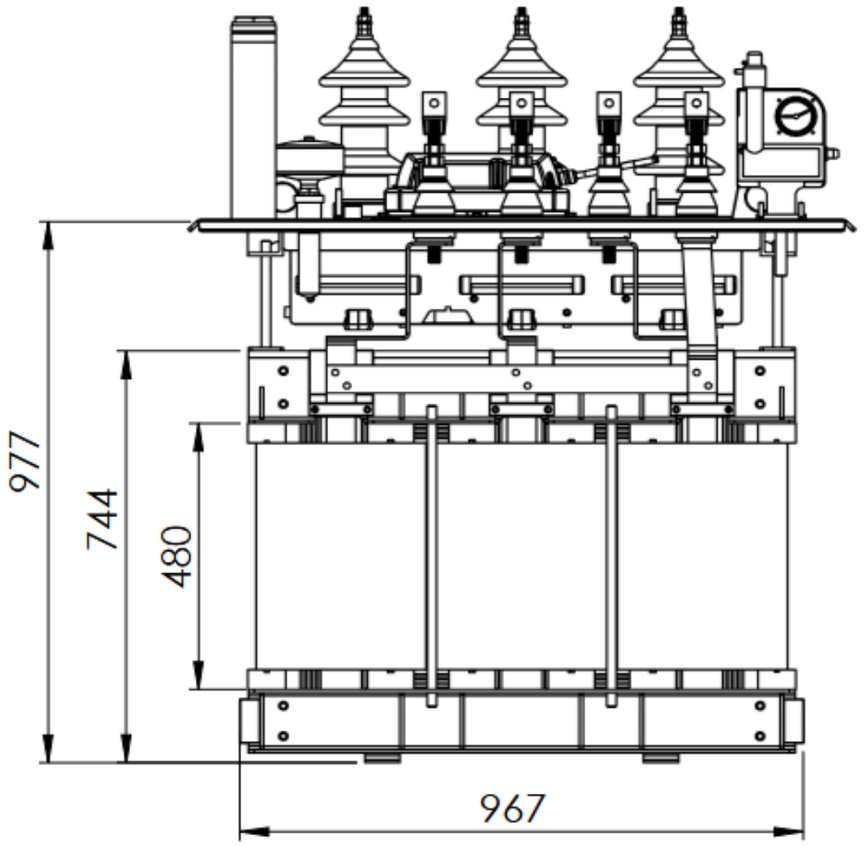
Winding	VN		NN		VN+NN
Connection	UST-A	GST g(A+B)	UST-A	GST g(A+B)	GST g(A+B)
Test voltage [kV]	9,98	9,99	0,997	1	1
Value of tanδ [%]	+0,269	+0,241	+0,268	+0,439	+0,411

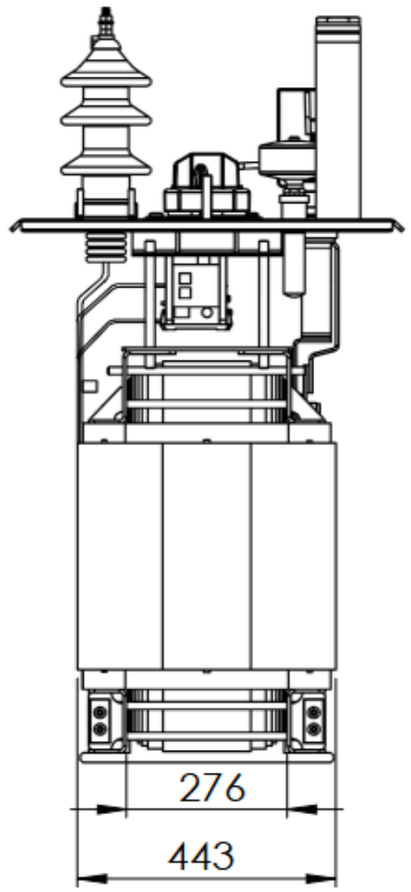
Dielectric strength coil is tested

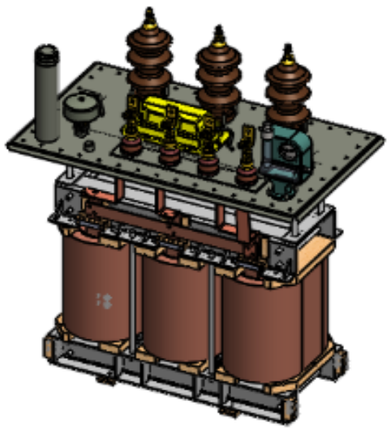
Applied voltage			Induced voltage test	
VN - (NN + ⏚)	50.0 kV	60 s	2 U2n 100 Hz is connected to a low voltage	
NN - (VN + ⏚)	10.0kV	60 s	0.840 kV	60 s
Well ☒	Not well ☐		Well ☒	Not well ☐

Remarks:

Tested:	Bački Vinogradi	Approved by:
Ivan Kuzmanov el. eng.	16.01.2025.	Gabor Tilinko el. tech.







Investitor: *Investor*	Naziv projekta: *Project title* ECO2T-400CH-22-3		Broj projekta: *Project number*
Termička obrada: *Heat treatment*		Površinska zaštita: *Surface protection*	Razmera: *Scale* 1:15 / Format: *Format* A4
Tolerancija slobodnih mera: *Tolerance* ISO2768-1m/ISO2768-2K	Kl.toler: *Tol. Class* S	Materijal: *Material* ---	Dimenzija: *Dimension* / Masa: *Mass* 1314 kg / Kom: *Qty.*

				Datum *Date*	17.01.2025
				Obradio *Author*	Tilinko Gabor
				Standard	
				Odobrio *Approved*	
A	XXX - 351	25.01.2015.	IA		
St.i. *Std*	Izmene *Revision*	Datum *Date*	Ime *Name*		

Naziv. *Title*

Assembled active part
ECO2T-400CH-22-3

ENERGOMONT

ISO 9001:2008
ISO 14001:2004
OHSAS 18001:2007
ID 9105047087

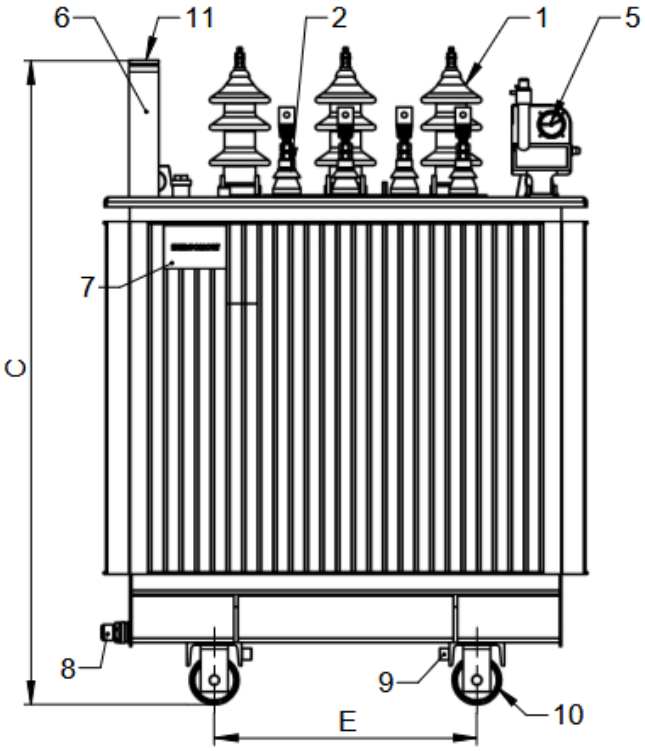
Oznaka. *Mark* V-025.001

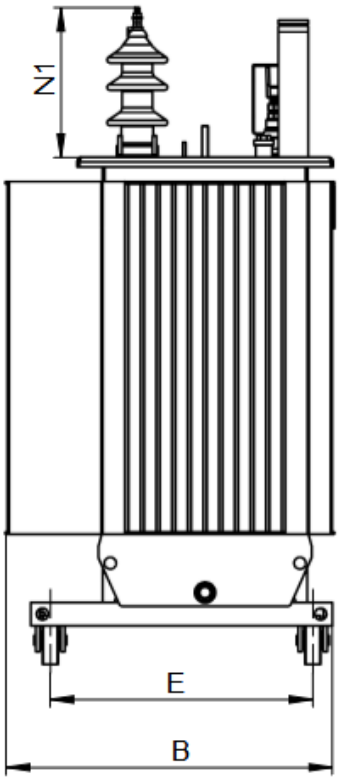
List: *Page* 1 / 1 — L

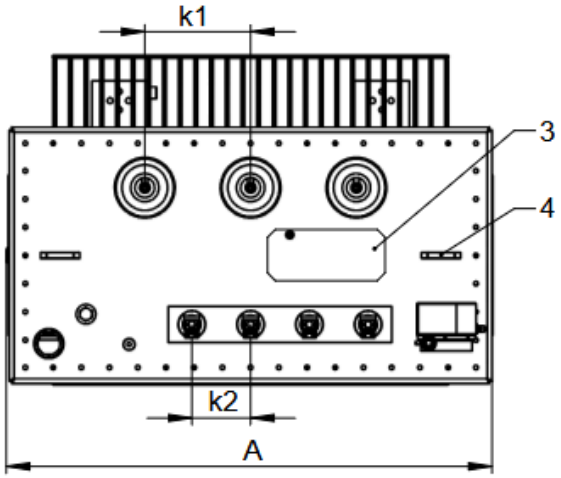
Izv. pod. *Source* | Zamena za: *Replacement*

ENERGOMONT
Bački Vinogradi

Three Phase
oil trasformer 400kVA,
22,0 ±4x2.5%/0,42kV, Dyn5







Type	ECO2T-400CH-22-3
Rated power	400 kVA
Rated voltage	22,0±4x2.5%/0,42kV
Rated current	10,50 / 549,86 A
Vector group	Dyn5
Short circuit voltage	4% ± 10%
No-load loss	$P_0 \leq 425$ W
Load loss at 75°C	$P_{K75} \leq 3250$ W
Standard	EN50464-1,IEC 60076-1

1. HV Bushing
2. LV Bushing
3. OLTC Tap changer
4. Lifting lug
5. Protection relay
6. Oil filling pipe
7. Nameplate
8. Oil drain device
9. Earthing terminal
10. Wheels
11. Pressure release valve

kVA	A	B	C	E	g	K1	K2	N1	N2	Weight (kg)	
400	1135	840	1530	670	160	270	150	385	176	Oil	Total
The given dimensions are informative										310	1850