	TYPE TEST PROTOCOL	Protocol No.
	TEMPERATURE RISE TEST	1738 / 272261

QUANTIFICATION OF WINDING TEMPERATURE RISE
LOW-VOLTAGE WINDING

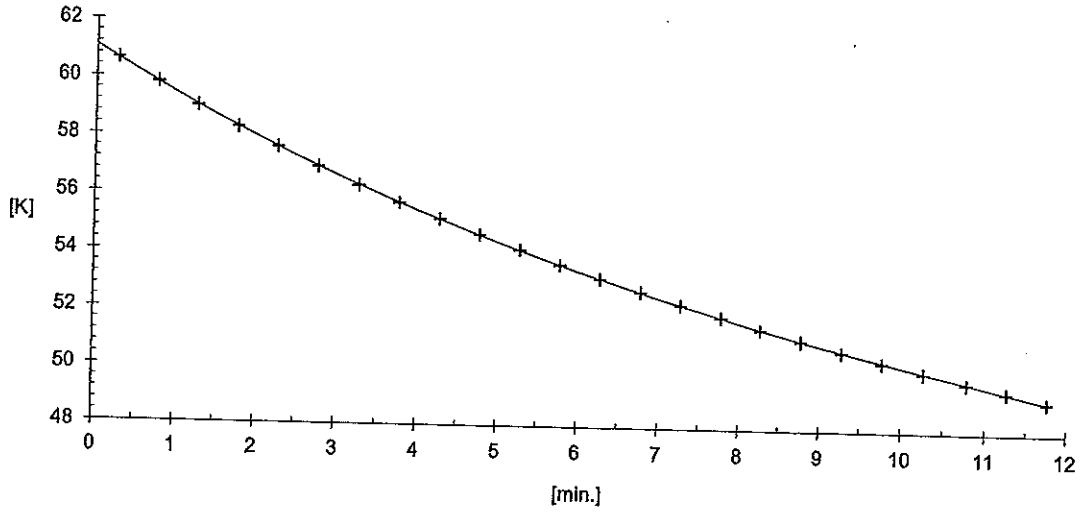
Count	Timer [h:m:s]	Current [A]	Resistance [Ω]	Temp.rise [K]	Extrapolation [K]
	0:00:00		0,0101806		55,5
1	0:00:16	14,1	0,0101710	55,2	55,2
2	0:00:46	14,4	0,0101530	54,7	54,7
3	0:01:16	14,4	0,0101350	54,1	54,1
4	0:01:46	14,3	0,0101190	53,6	53,6
5	0:02:16	14,3	0,0101030	53,1	53,1
6	0:02:46	14,3	0,0100880	52,7	52,7
7	0:03:16	14,3	0,0100740	52,2	52,2
8	0:03:46	14,3	0,0100610	51,8	51,8
9	0:04:16	14,3	0,0100490	51,4	51,4
10	0:04:46	14,3	0,0100370	51,1	51,1
11	0:05:16	14,3	0,0100260	50,7	50,7
12	0:05:46	14,3	0,0100140	50,4	50,4
13	0:06:16	14,3	0,0100040	50,1	50,0
14	0:06:46	14,3	0,0099941	49,7	49,7
15	0:07:16	14,3	0,0099843	49,4	49,4
16	0:07:46	14,3	0,0099750	49,2	49,2
17	0:08:16	14,3	0,0099654	48,9	48,9
18	0:08:46	14,3	0,0099570	48,6	48,6
19	0:09:16	14,3	0,0099484	48,3	48,3
20	0:09:46	14,3	0,0099402	48,1	48,1
21	0:10:16	14,3	0,0099324	47,8	47,9
22	0:10:46	14,3	0,0099246	47,6	47,6
23	0:11:16	14,3	0,0099178	47,4	47,4
24	0:11:46	14,3	0,0099100	47,1	47,1

Winding resistance I.	:	0,0083809	Ω
Winding resistance II.	:	0,0101806	Ω
Temperature of winding I.	:	24,5	°C
Ambient-air temperature II.	:	24,7	°C
Winding temperature-rise correction	:	0,4	K
Average temperature rise of LV winding	:	55,9	K
Max. temperature rise of oil	:	45,7	K

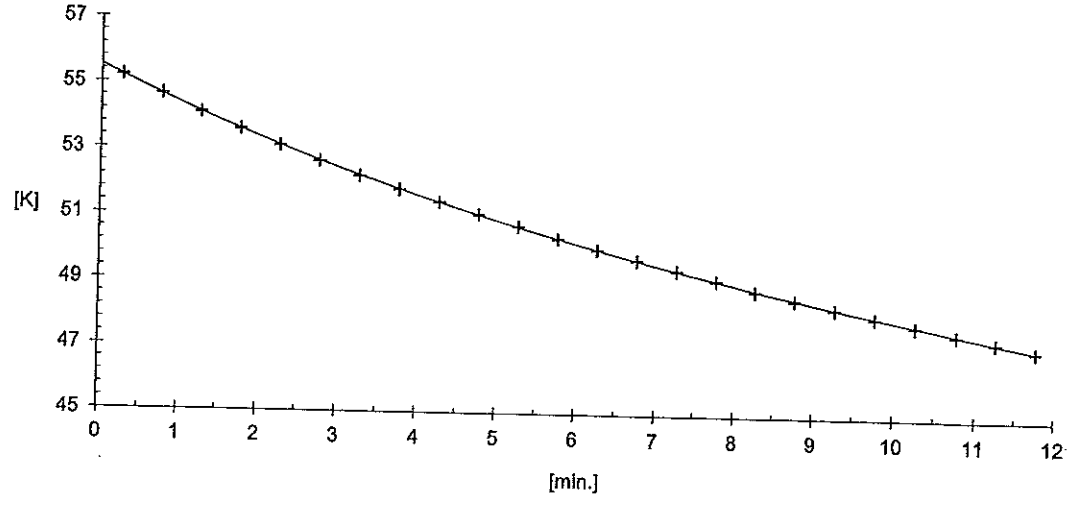
	TYPE TEST PROTOCOL	Protocol No.
	TEMPERATURE RISE TEST	1738 / 272261

QUANTIFICATION OF WINDING TEMPERATURE RISE

High-voltage winding



Low-voltage winding



	B E Z Transformátory a.s.	Protocol No.
	Testing department	1741 / 273343

TEST REPORT

TEMPERATURE RISE TEST

1.	Test object		:	Transformer - TOHn 339/22	
2.	Serial No.		:	363132	
3.	Working No.		:	12.01.00762.01.01	
4.	Winding datum		:	33900-629	
5.	Specification		:	291865/9	
6.	Rated power [kVA]		:	250	kVA
7.	Rated voltage	- HV	:	20 000 ± 2×2,5%	V
		- LV	:	400 / 231	V
8.	Rated current	- HV	:	7,22	A
		- LV	:	360,84	A
9.	Connection		:	Dyn5	
10.	Frequency		:	50	Hz
11.	Cooling		:	ONAN	
12.	Class insulation		:	A	

Test according to	:	EN 60076-2:2011, clause 7.
Method of loading	:	Short-circuit method. Transfomer was loaded with total losses 3283,2 W.

TEST RESULTS

Average temperature rise of HV winding	:	$\Delta\Theta_{WHV}$ =	62,8	K
Average temperature rise of LV winding	:	$\Delta\Theta_{WLV}$ =	56,2	K
Max. temperature rise of oil	:	$\Delta\Theta_{o}$ =	48,3	K
Ambient-air temperature	:	Θ_{a} =	26,5	°C

Transformer **p a s s e d** the temperature rise test in compliance with standard - EN 60076-2:2011, clause 6.

Date of test : 2.6.2016
Tested by : Peter HRÍBIK

BEZ TRANSFORMÁTORY a.s.
Funkčná a výstupná kontrola
Rybničná 40
835 64 Bratislava

Štefan Tkáč
Functional and final inspection dpt.

Bratislava, 6.6.2016

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	TYPE TEST PROTOCOL	Protocol No.
	TEMPERATURE RISE TEST	1741 / 273343

QUANTIFICATION OF WINDING TEMPERATURE RISE
HIGH-VOLTAGE WINDING

Count	Timer [h:m:s]	Current [A]	Resistance [Ω]	Temp.rise [K]	Extrapolation [K]
	0:00:00		20,354		63,4
1	0:00:20	0,720	20,326	63,0	63,0
2	0:00:50	0,720	20,286	62,3	62,3
3	0:01:20	0,720	20,246	61,7	61,7
4	0:01:50	0,720	20,209	61,1	61,1
5	0:02:20	0,721	20,172	60,5	60,5
6	0:02:50	0,721	20,139	60,0	60,0
7	0:03:20	0,721	20,105	59,4	59,5
8	0:03:50	0,721	20,074	59,0	59,0
9	0:04:20	0,721	20,044	58,5	58,5
10	0:04:50	0,721	20,015	58,0	58,0
11	0:05:20	0,721	19,988	57,6	57,6
12	0:05:50	0,721	19,961	57,2	57,1
13	0:06:20	0,720	19,934	56,7	56,7
14	0:06:50	0,720	19,910	56,3	56,3
15	0:07:20	0,720	19,886	56,0	56,0
16	0:07:50	0,720	19,863	55,6	55,6
17	0:08:20	0,721	19,841	55,2	55,2
18	0:08:50	0,721	19,818	54,9	54,9
19	0:09:20	0,720	19,797	54,5	54,5
20	0:09:50	0,720	19,777	54,2	54,2
21	0:10:20	0,720	19,757	53,9	53,9
22	0:10:50	0,720	19,737	53,6	53,6
23	0:11:20	0,720	19,718	53,3	53,3
24	0:11:50	0,720	19,699	53,0	53,0

Winding resistance I.	:	16,287	Ω
Winding resistance II.	:	20,354	Ω
Temperature of winding I.	:	25,0	°C
Ambient-air temperature II.	:	26,5	°C
Winding temperature-rise correction	:	-0,65	K
Average temperature rise of HV winding	:	62,8	K
Max. temperature rise of oil	:	48,3	K

	TYPE TEST PROTOCOL	Protocol No.
	TEMPERATURE RISE TEST	1741 / 273343

QUANTIFICATION OF WINDING TEMPERATURE RISE

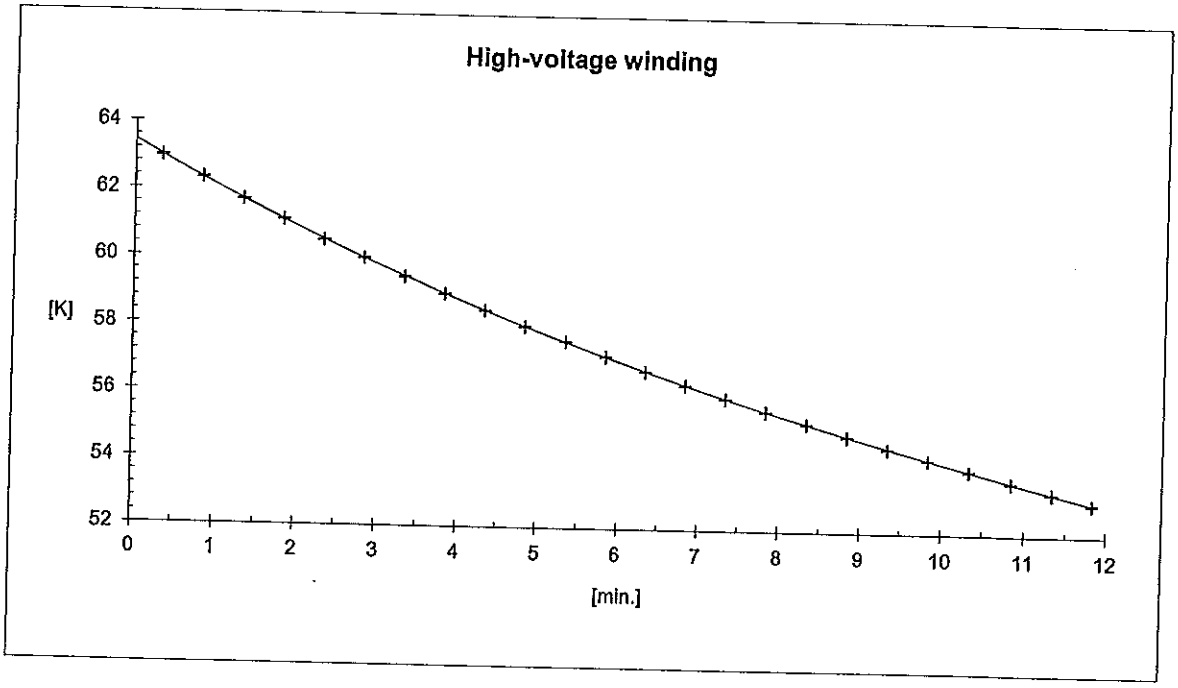
LOW-VOLTAGE WINDING

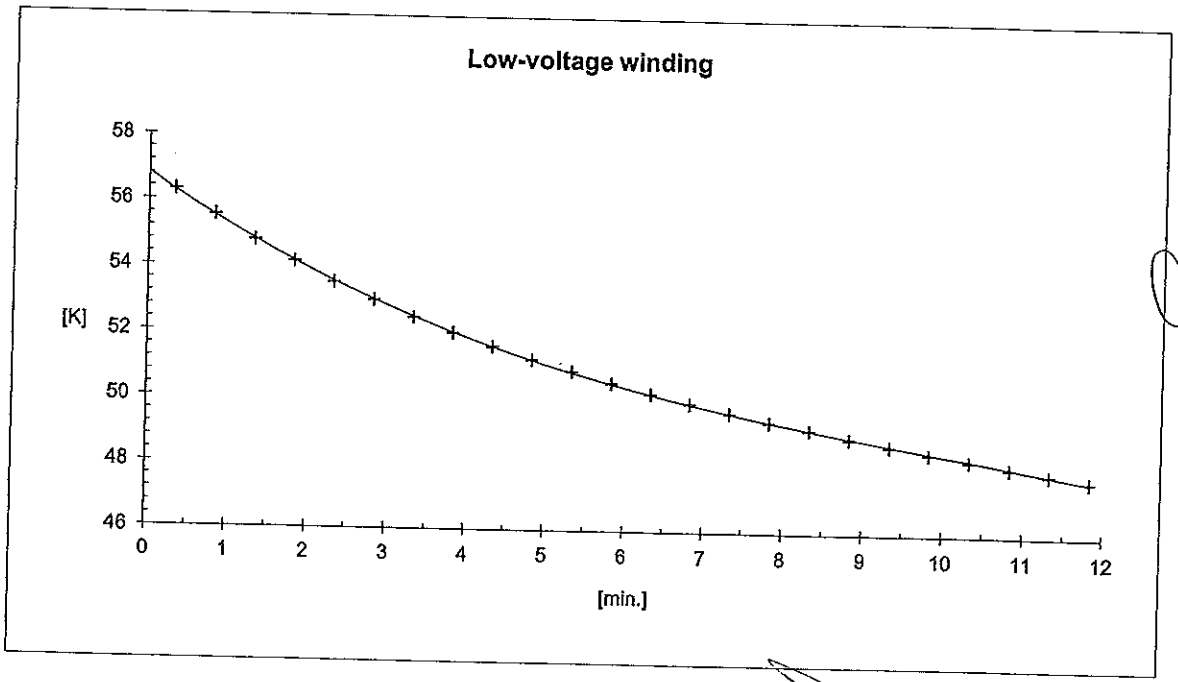
Count	Timer [h:m:s]	Current [A]	Resistance [Ω]	Temp.rise [K]	Extrapolation [K]
	0:00:00		0,007082		56,8
1	0:00:20	15,6	0,007071	56,3	56,3
2	0:00:50	16,0	0,007054	55,5	55,5
3	0:01:20	15,9	0,007038	54,8	54,8
4	0:01:50	15,9	0,007023	54,1	54,2
5	0:02:20	15,9	0,007009	53,5	53,6
6	0:02:50	15,9	0,006997	53,0	53,0
7	0:03:20	15,9	0,006986	52,5	52,5
8	0:03:50	15,9	0,006976	52,0	52,0
9	0:04:20	15,9	0,006967	51,6	51,6
10	0:04:50	15,9	0,006958	51,2	51,2
11	0:05:20	15,9	0,006951	50,9	50,8
12	0:05:50	15,9	0,006943	50,5	50,5
13	0:06:20	15,9	0,006936	50,2	50,2
14	0:06:50	15,9	0,006930	49,9	49,9
15	0:07:20	15,9	0,006924	49,7	49,7
16	0:07:50	15,9	0,006918	49,4	49,4
17	0:08:20	15,9	0,006913	49,2	49,2
18	0:08:50	15,9	0,006907	48,9	49,0
19	0:09:20	15,9	0,006902	48,7	48,7
20	0:09:50	15,9	0,006898	48,5	48,5
21	0:10:20	15,9	0,006893	48,3	48,3
22	0:10:50	15,9	0,006889	48,1	48,1
23	0:11:20	15,9	0,006884	47,9	47,9
24	0:11:50	15,9	0,006880	47,7	47,7

Winding resistance I.	:	0,005785	Ω
Winding resistance II.	:	0,007082	Ω
Temperature of winding I.	:	25,0	°C
Ambient-air temperature II.	:	26,5	°C
Winding temperature-rise correction	:	-0,65	K
Average temperature rise of LV winding	:	56,2	K
Max. temperature rise of oil	:	48,3	K

	TYPE TEST PROTOCOL	Protocol No.
	TEMPERATURE RISE TEST	1741 / 273343

QUANTIFICATION OF WINDING TEMPERATURE RISE





	B E Z Transformátory a.s.	Protocol No.
	Testing department	1740 / 273473

TEST REPORT

TEMPERATURE RISE TEST

1.	Test object		:	Transformer - TOHn 359/22	
2.	Serial No.		:	363336	
3.	Working No.		:	12.01.00764.01.01	
4.	Winding datum		:	35900-629	
5.	Specification		:	291866/2	
6.	Rated power [kVA]		:	400	kVA
7.	Rated voltage	- HV	:	20 000 ± 2×2,5%	V
		- LV	:	400 / 231	V
8.	Rated current	- HV	:	11,55	A
		- LV	:	577,35	A
9.	Connection		:	Dyn5	
10.	Frequency		:	50	Hz
11.	Cooling		:	ONAN	
12.	Class insulation		:	A	

Test according to	:	EN 60076-2:2011, clause 7.
Method of loading	:	Short-circuit method. Transfomer was loaded with total losses 5022,3 W.

TEST RESULTS

Average temperature rise of HV winding	:	$\Delta\Theta_{WHV}$ =	61,3	K
Average temperature rise of LV winding	:	$\Delta\Theta_{WLV}$ =	61,4	K
Max. temperature rise of oil	:	$\Delta\Theta_{o}$ =	50,5	K
Ambient-air temperature	:	Θ_{a} =	27,0	°C

Transformer **p a s s e d** the temperature rise test in compliance with standard - EN 60076-2:2011, clause 6.

Date of test : 31.5.2016
Tested by : Peter HRÍBIK

BEZ TRANSFORMÁTORY a.s.
Funkčná a výstupná kontrola
Rybničná 40
835 54 Bratislava

Štefan Tkáč
Functional and final inspection dpt.

Bratislava, 2.6.2016

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	TYPE TEST PROTOCOL	Protocol No.
	TEMPERATURE RISE TEST	1740 / 273473

QUANTIFICATION OF WINDING TEMPERATURE RISE

HIGH-VOLTAGE WINDING

Count	Timer [h:m:s]	Current [A]	Resistance [Ω]	Temp.rise [K]	Extrapolation [K]
	0:00:00		11,482		62,4
1	0:00:23	0,993	11,463	61,8	61,8
2	0:00:53	0,994	11,439	61,2	61,1
3	0:01:23	0,995	11,415	60,5	60,5
4	0:01:53	0,995	11,393	59,9	59,9
5	0:02:23	0,996	11,372	59,3	59,3
6	0:02:53	0,996	11,353	58,7	58,7
7	0:03:23	0,996	11,334	58,2	58,2
8	0:03:53	0,996	11,317	57,7	57,7
9	0:04:23	0,996	11,300	57,2	57,2
10	0:04:53	0,995	11,284	56,8	56,8
11	0:05:23	0,995	11,270	56,4	56,4
12	0:05:53	0,995	11,255	56,0	55,9
13	0:06:23	0,995	11,241	55,6	55,6
14	0:06:53	0,995	11,228	55,2	55,2
15	0:07:23	0,995	11,215	54,8	54,8
16	0:07:53	0,995	11,203	54,5	54,5
17	0:08:23	0,995	11,191	54,1	54,2
18	0:08:53	0,996	11,180	53,8	53,8
19	0:09:23	0,995	11,168	53,5	53,5
20	0:09:53	0,995	11,157	53,2	53,2
21	0:10:23	0,995	11,147	52,9	52,9
22	0:10:53	0,995	11,136	52,6	52,6
23	0:11:23	0,995	11,126	52,3	52,3
24	0:11:53	0,995	11,116	52,0	52,0

Winding resistance I.	:	9,2035	Ω
Winding resistance II.	:	11,482	Ω
Temperature of winding I.	:	25,0	°C
Ambient-air temperature II.	:	27,0	°C
Winding temperature-rise correction	:	-1,1	K
Average temperature rise of HV winding	:	61,3	K
Max. temperature rise of oil	:	50,5	K

	TYPE TEST PROTOCOL	Protocol No.
	TEMPERATURE RISE TEST	1740 / 273473

QUANTIFICATION OF WINDING TEMPERATURE RISE

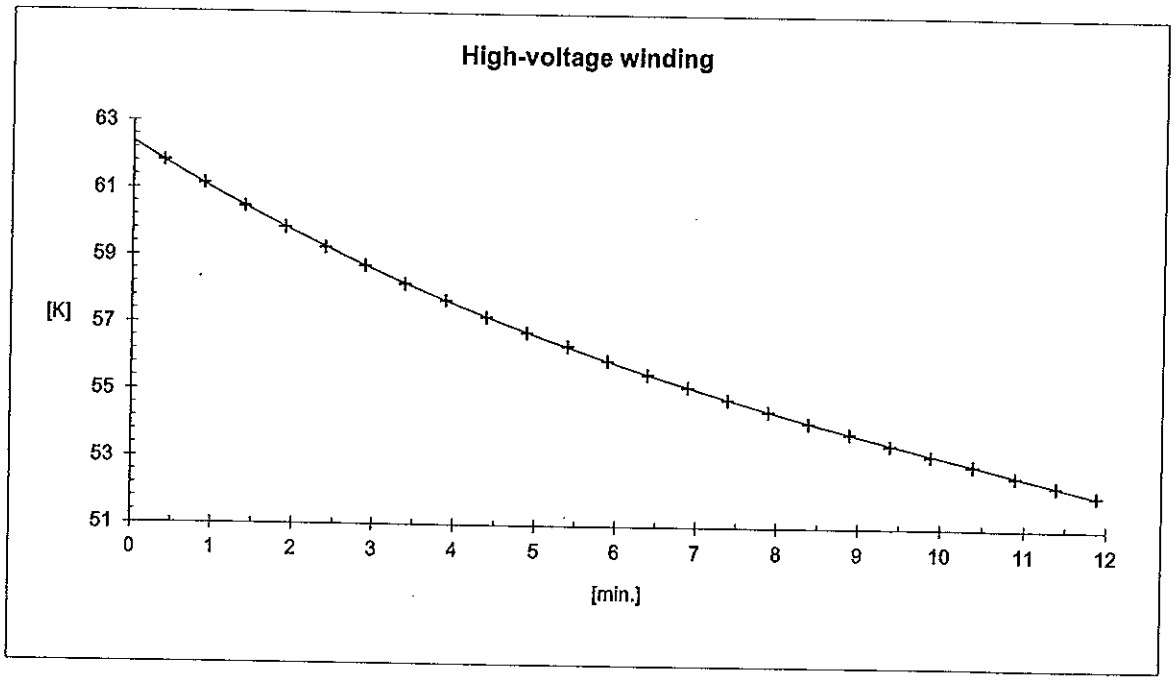
LOW-VOLTAGE WINDING

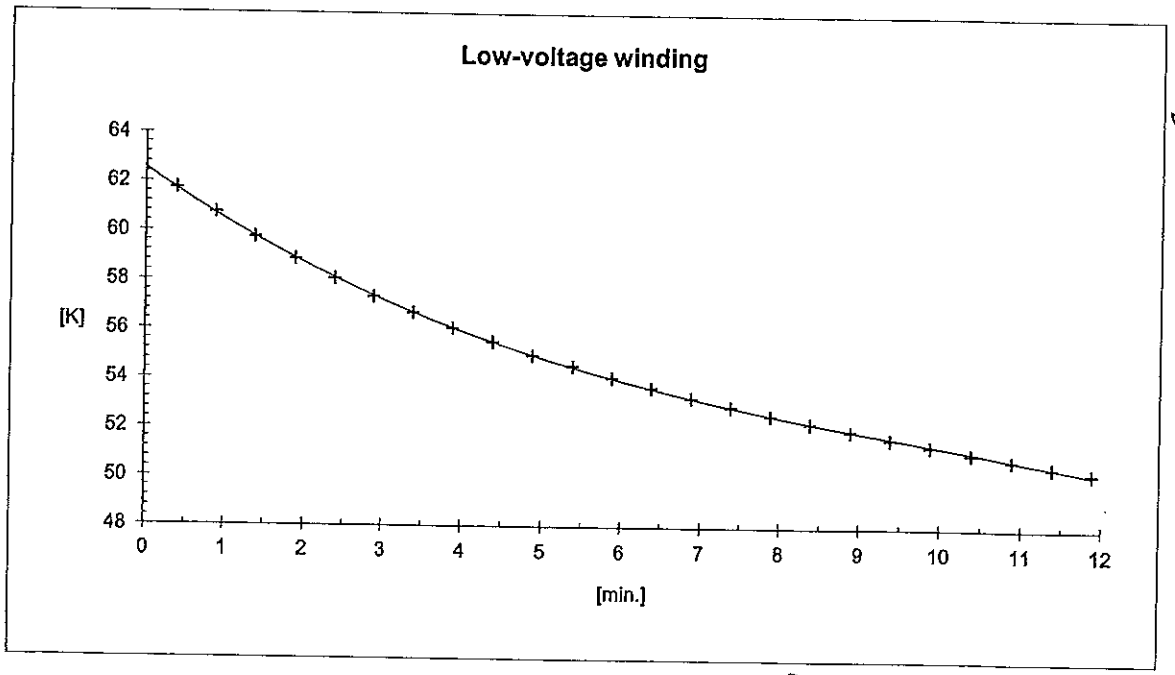
Count	Timer [h:m:s]	Current [A]	Resistance [Ω]	Temp.rise [K]	Extrapolation [K]
	0:00:00		0,0046299		62,5
1	0:00:23	15,6	0,0046185	61,7	61,7
2	0:00:53	16,0	0,0046044	60,7	60,7
3	0:01:23	15,9	0,0045903	59,8	59,8
4	0:01:53	15,9	0,0045776	58,9	58,9
5	0:02:23	15,9	0,0045663	58,1	58,1
6	0:02:53	15,9	0,0045558	57,3	57,4
7	0:03:23	15,9	0,0045465	56,7	56,7
8	0:03:53	15,9	0,0045379	56,1	56,1
9	0:04:23	15,9	0,0045300	55,5	55,5
10	0:04:53	15,9	0,0045224	55,0	55,0
11	0:05:23	15,9	0,0045161	54,6	54,5
12	0:05:53	15,9	0,0045096	54,1	54,1
13	0:06:23	15,9	0,0045038	53,7	53,7
14	0:06:53	15,9	0,0044981	53,3	53,3
15	0:07:23	15,9	0,0044931	52,9	52,9
16	0:07:53	15,9	0,0044881	52,6	52,6
17	0:08:23	15,9	0,0044836	52,3	52,3
18	0:08:53	15,9	0,0044793	52,0	52,0
19	0:09:23	15,9	0,0044748	51,7	51,7
20	0:09:53	15,9	0,0044707	51,4	51,4
21	0:10:23	15,9	0,0044665	51,1	51,1
22	0:10:53	15,9	0,0044628	50,8	50,8
23	0:11:23	15,9	0,0044590	50,6	50,6
24	0:11:53	15,9	0,0044555	50,3	50,3

Winding resistance I.	:	0,0037092	Ω
Winding resistance II.	:	0,0046299	Ω
Temperature of winding I.	:	25,0	°C
Ambient-air temperature II.	:	27,0	°C
Winding temperature-rise correction	:	-1,1	K
Average temperature rise of LV winding	:	61,4	K
Max. temperature rise of oil	:	50,5	K

	TYPE TEST PROTOCOL	Protocol No.
	TEMPERATURE RISE TEST	1740 / 273473

QUANTIFICATION OF WINDING TEMPERATURE RISE





B E Z Transformátory a.s.	Protocol No.
Testing department	1743 / 273348

TEST REPORT

TEMPERATURE RISE TEST

1.	Test object		:	Transformer - TOHn 379/22	
2.	Serial No.		:	363137	
3.	Working No.		:	12.01.00763.01.01	
4.	Winding datum		:	37900-636	
5.	Specification		:	291868/4	
6.	Rated power [kVA]		:	630	kVA
7.	Rated voltage	- HV	:	20 000 ± 2×2,5%	V
		- LV	:	400 / 231	V
8.	Rated current	- HV	:	18,19	A
		- LV	:	909,33	A
9.	Connection		:	Dyn5	
10.	Frequency		:	50	Hz
11.	Cooling		:	ONAN	
12.	Class insulation		:	A	

Test according to	:	EN 60076-2:2011, clause 7.
Method of loading	:	Short-circuit method. Transfomer was loaded with total losses 7038,3 W.

TEST RESULTS

Average temperature rise of HV winding	:	$\Delta\Theta_{WHV}$ =	64,9	K
Average temperature rise of LV winding	:	$\Delta\Theta_{WLV}$ =	64,6	K
Max. temperature rise of oil	:	$\Delta\Theta_{o}$ =	52,2	K
Ambient-air temperature	:	Θ_{a} =	27,0	°C

Transformer **p a s s e d** the temperature rise test in compliance with standard - EN 60076-2:2011, clause 6.

Date of test : 9.6.2016
Tested by : Peter HRÍBIK

BEZ TRANSFORMATORY a.s.
Funkčná a výstupná kontrola
Rybničná 40
836 54 Bratislava

Štefan Tkáč
Functional and final inspection dpt.

Bratislava, 13.6.2016

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	TYPE TEST PROTOCOL	Protocol No.
	TEMPERATURE RISE TEST	1743 / 273348

QUANTIFICATION OF WINDING TEMPERATURE RISE
HIGH-VOLTAGE WINDING

Count	Timer [h:m:s]	Current [A]	Resistance [Ω]	Temp.rise [K]	Extrapolation [K]
	0:00:00		6,4935		64,7
1	0:00:28	1,80	6,4780	64,0	64,0
2	0:00:58	1,80	6,4621	63,2	63,1
3	0:01:28	1,80	6,4462	62,4	62,4
4	0:01:58	1,81	6,4315	61,6	61,6
5	0:02:28	1,81	6,4177	60,9	60,9
6	0:02:58	1,81	6,4047	60,3	60,3
7	0:03:28	1,81	6,3921	59,6	59,7
8	0:03:58	1,81	6,3803	59,0	59,1
9	0:04:28	1,81	6,3692	58,5	58,5
10	0:04:58	1,81	6,3584	57,9	57,9
11	0:05:28	1,81	6,3482	57,4	57,4
12	0:05:58	1,81	6,3382	56,9	56,9
13	0:06:28	1,81	6,3286	56,4	56,4
14	0:06:58	1,81	6,3196	56,0	56,0
15	0:07:28	1,81	6,3109	55,6	55,6
16	0:07:58	1,81	6,3026	55,1	55,1
17	0:08:28	1,81	6,2944	54,7	54,7
18	0:08:58	1,81	6,2865	54,3	54,3
19	0:09:28	1,81	6,2788	53,9	54,0
20	0:09:58	1,81	6,2714	53,6	53,6
21	0:10:28	1,80	6,2641	53,2	53,2
22	0:10:58	1,81	6,2571	52,8	52,9
23	0:11:28	1,81	6,2504	52,5	52,5
24	0:11:58	1,81	6,2437	52,2	52,2

Winding resistance I.	:	5,1651	Ω
Winding resistance II.	:	6,4935	Ω
Temperature of winding I.	:	24,9	°C
Ambient-air temperature II.	:	27,0	°C
Winding temperature-rise correction	:	0,2	K
Average temperature rise of HV winding	:	64,9	K
Max. temperature rise of oil	:	52,2	K

	TYPE TEST PROTOCOL	Protocol No.
	TEMPERATURE RISE TEST	1743 / 273348

QUANTIFICATION OF WINDING TEMPERATURE RISE

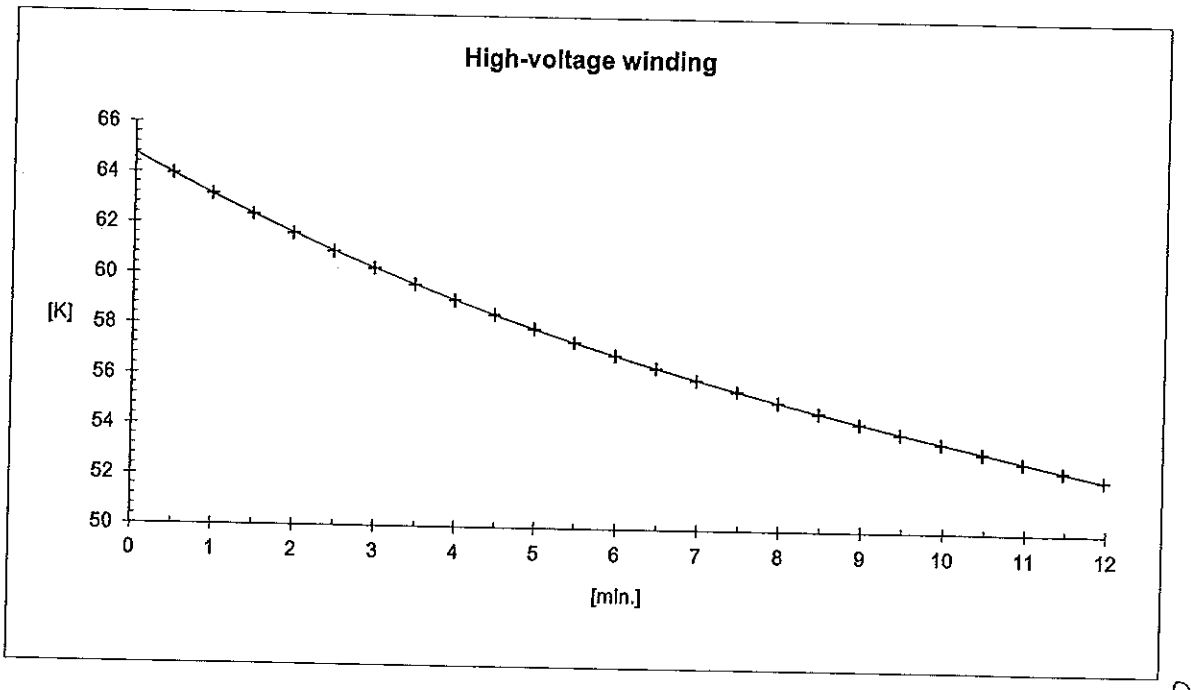
LOW-VOLTAGE WINDING

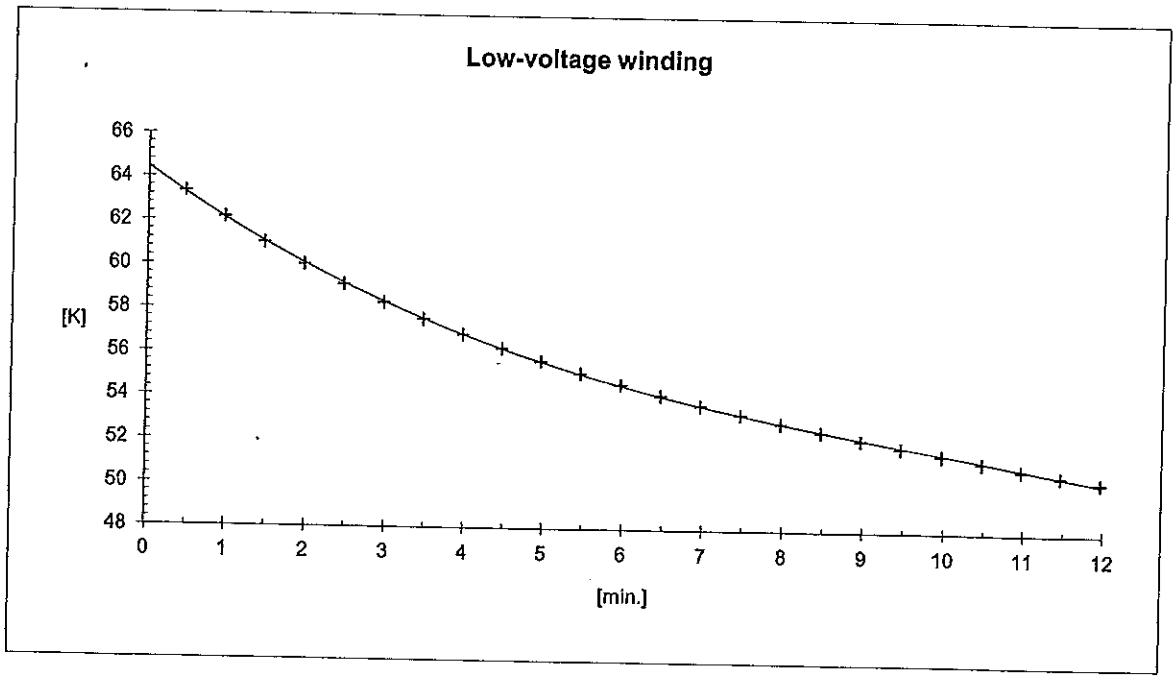
Count	Timer [h:m:s]	Current [A]	Resistance [Ω]	Temp.rise [K]	Extrapolation [K]
	0:00:00		0,0026582		64,4
1	0:00:28	15,6	0,0026494	63,3	63,3
2	0:00:58	16,0	0,0026400	62,2	62,1
3	0:01:28	15,9	0,0026306	61,0	61,1
4	0:01:58	15,9	0,0026225	60,0	60,1
5	0:02:28	15,9	0,0026152	59,1	59,2
6	0:02:58	15,9	0,0026085	58,3	58,4
7	0:03:28	15,9	0,0026024	57,6	57,6
8	0:03:58	15,9	0,0025968	56,9	56,9
9	0:04:28	15,9	0,0025918	56,3	56,2
10	0:04:58	15,9	0,0025871	55,7	55,7
11	0:05:28	15,9	0,0025828	55,2	55,1
12	0:05:58	15,9	0,0025787	54,7	54,6
13	0:06:28	15,9	0,0025748	54,2	54,1
14	0:06:58	15,9	0,0025713	53,7	53,7
15	0:07:28	15,9	0,0025680	53,3	53,3
16	0:07:58	15,9	0,0025649	53,0	52,9
17	0:08:28	15,9	0,0025618	52,6	52,6
18	0:08:58	15,9	0,0025589	52,2	52,3
19	0:09:28	15,9	0,0025562	51,9	51,9
20	0:09:58	15,9	0,0025536	51,6	51,6
21	0:10:28	15,9	0,0025510	51,3	51,3
22	0:10:58	15,9	0,0025485	50,9	51,0
23	0:11:28	15,9	0,0025463	50,7	50,7
24	0:11:58	15,9	0,0025440	50,4	50,3

Winding resistance I.	:	0,0021165	Ω
Winding resistance II.	:	0,0026582	Ω
Temperature of winding I.	:	24,9	°C
Ambient-air temperature II.	:	27,0	°C
Winding temperature-rise correction	:	0,2	K
Average temperature rise of LV winding	:	64,6	K
Max. temperature rise of oil	:	52,2	K

	TYPE TEST PROTOCOL	Protocol No.
	TEMPERATURE RISE TEST	1743 / 273348

QUANTIFICATION OF WINDING TEMPERATURE RISE





	B E Z Transformátory a.s.	Protocol No.
	Testing department	1742 / 272012

TEST REPORT

TEMPERATURE RISE TEST

1.	Test object		:	Transformer - TOHn 389/22	
2.	Serial No.		:	361831	
3.	Working No.		:	12.01.00535.03.01	
4.	Winding datum		:	38900-607	
5.	Specification		:	291895/8	
6.	Rated power [kVA]		:	800	kVA
7.	Rated voltage	- HV	:	20 000 ± 2×2,5%	V
		- LV	:	400 / 231	V
8.	Rated current	- HV	:	23,09	A
		- LV	:	1154,7	A
9.	Connection		:	Dyn5	
10.	Frequency		:	50	Hz
11.	Cooling		:	ONAN	
12.	Class insulation		:	A	

Test according to	:	EN 60076-2:2011, clause 7.
Method of loading	:	Short-circuit method. Transfomer was loaded with total losses 8631,1 W.

TEST RESULTS

Average temperature rise of HV winding	:	$\Delta\Theta_{WHV}$ =	62,5	K
Average temperature rise of LV winding	:	$\Delta\Theta_{WLV}$ =	57,6	K
Max. temperature rise of oil	:	$\Delta\Theta_{o}$ =	48,8	K
Ambient-air temperature	:	Θ_{a} =	26,0	°C

Transformer **p a s s e d** the temperature rise test in compliance with standard - EN 60076-2:2011, clause 6.

Date of test : 7.6.2016
Tested by : Peter HRÍBIK

BEZ TRANSFORMÁTORY a.s.
Funkčná a výstupná kontrola
Rybničná 40
835 54 B r a t i s l a v a

Štefan Tkáč
Functional and final inspection dpt.

Bratislava, 10.6.2016

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	TYPE TEST PROTOCOL	Protocol No.
	TEMPERATURE RISE TEST	1742 / 272012

QUANTIFICATION OF WINDING TEMPERATURE RISE

HIGH-VOLTAGE WINDING

Count	Timer [h:m:s]	Current [A]	Resistance [Ω]	Temp.rise [K]	Extrapolation [K]
	0:00:00		4,8950		62,6
1	0:00:24	0,995	4,8859	62,0	62,0
2	0:00:54	0,996	4,8759	61,3	61,3
3	0:01:24	0,997	4,8659	60,6	60,6
4	0:01:54	0,997	4,8557	60,0	60,0
5	0:02:24	0,997	4,8461	59,3	59,3
6	0:02:54	0,998	4,8372	58,7	58,7
7	0:03:24	0,998	4,8286	58,2	58,2
8	0:03:54	0,998	4,8201	57,6	57,6
9	0:04:24	0,998	4,8126	57,1	57,1
10	0:04:54	0,997	4,8048	56,6	56,6
11	0:05:24	0,997	4,7973	56,1	56,1
12	0:05:54	0,997	4,7904	55,6	55,6
13	0:06:24	0,997	4,7836	55,2	55,2
14	0:06:54	0,998	4,7769	54,8	54,7
15	0:07:24	0,998	4,7705	54,3	54,3
16	0:07:54	0,998	4,7642	53,9	53,9
17	0:08:24	0,998	4,7581	53,5	53,5
18	0:08:54	0,997	4,7524	53,1	53,1
19	0:09:24	0,997	4,7462	52,7	52,7
20	0:09:54	0,997	4,7407	52,4	52,4
21	0:10:24	0,997	4,7354	52,0	52,0
22	0:10:54	0,997	4,7297	51,6	51,6
23	0:11:24	0,998	4,7247	51,3	51,3
24	0:11:54	0,998	4,7196	51,0	50,9

Winding resistance I.	:	3,9259	Ω
Winding resistance II.	:	4,8950	Ω
Temperature of winding I.	:	24,5	°C
Ambient-air temperature II.	:	26,0	°C
Winding temperature-rise correction	:	-0,1	K
Average temperature rise of HV winding	:	62,5	K
Max. temperature rise of oil	:	48,8	K

	TYPE TEST PROTOCOL	Protocol No.
	TEMPERATURE RISE TEST	1742 / 272012

QUANTIFICATION OF WINDING TEMPERATURE RISE

LOW-VOLTAGE WINDING

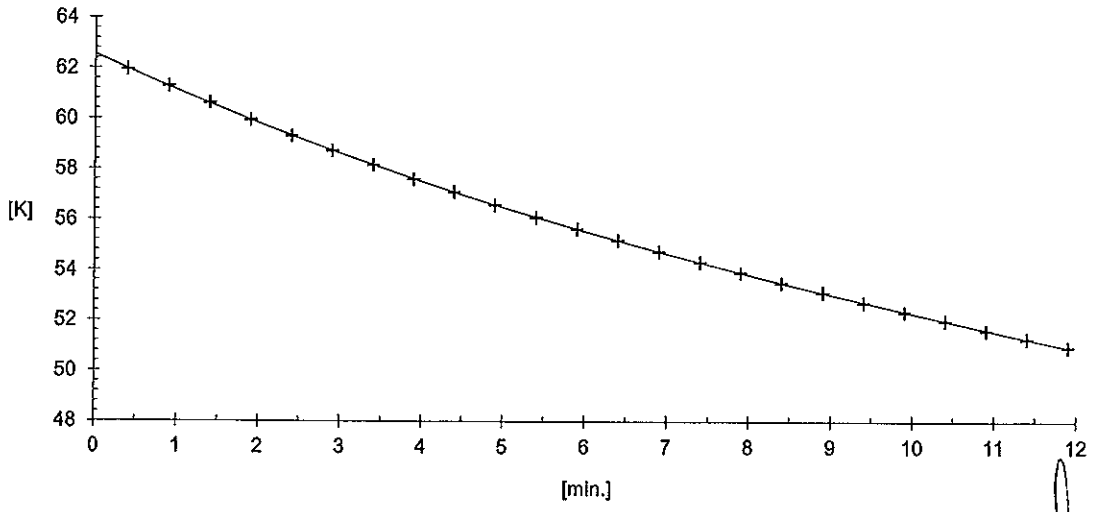
Count	Timer [h:m:s]	Current [A]	Resistance [Ω]	Temp.rise [K]	Extrapolation [K]
	0:00:00		0,0018955		57,7
1	0:00:24	15,6	0,0018908	56,9	56,9
2	0:00:54	16,0	0,0018855	56,0	56,0
3	0:01:24	15,9	0,0018802	55,1	55,1
4	0:01:54	15,9	0,0018751	54,3	54,3
5	0:02:24	15,9	0,0018706	53,5	53,6
6	0:02:54	15,9	0,0018666	52,9	52,9
7	0:03:24	15,9	0,0018630	52,3	52,3
8	0:03:54	15,9	0,0018595	51,7	51,7
9	0:04:24	15,9	0,0018568	51,2	51,2
10	0:04:54	15,9	0,0018538	50,7	50,7
11	0:05:24	15,9	0,0018511	50,3	50,2
12	0:05:54	15,9	0,0018488	49,9	49,8
13	0:06:24	15,9	0,0018465	49,5	49,4
14	0:06:54	15,9	0,0018443	49,1	49,1
15	0:07:24	15,9	0,0018423	48,8	48,8
16	0:07:54	15,9	0,0018404	48,5	48,4
17	0:08:24	15,9	0,0018385	48,1	48,1
18	0:08:54	15,9	0,0018369	47,9	47,9
19	0:09:24	15,9	0,0018349	47,5	47,6
20	0:09:54	15,9	0,0018334	47,3	47,3
21	0:10:24	15,9	0,0018319	47,0	47,1
22	0:10:54	15,9	0,0018303	46,8	46,8
23	0:11:24	15,9	0,0018290	46,5	46,5
24	0:11:54	15,9	0,0018276	46,3	46,2

Winding resistance I.	:	0,0015433	Ω
Winding resistance II.	:	0,0018955	Ω
Temperature of winding I.	:	24,5	°C
Ambient-air temperature II.	:	26,0	°C
Winding temperature-rise correction	:	-0,1	K
Average temperature rise of LV winding	:	57,6	K
Max. temperature rise of oil	:	48,8	K

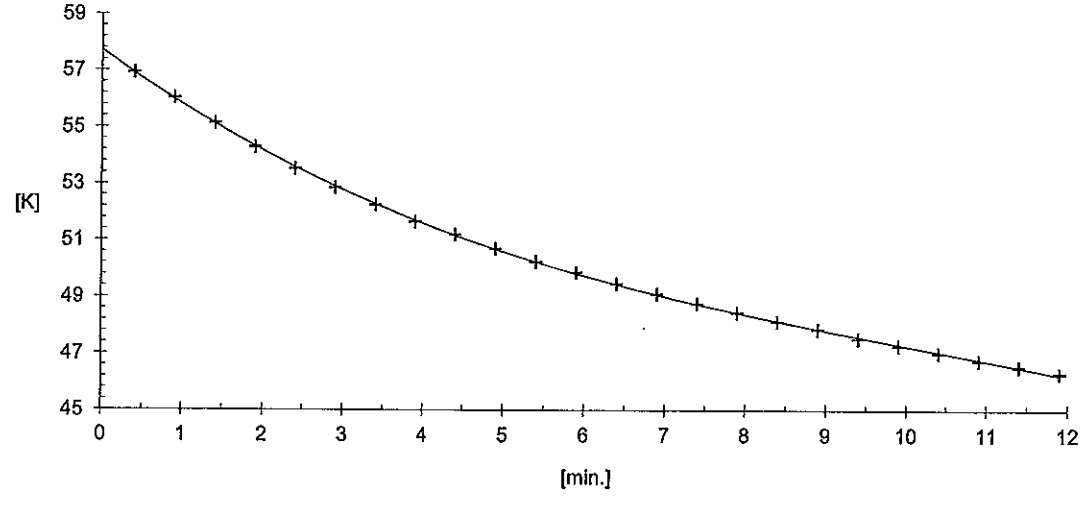
	TYPE TEST PROTOCOL	Protocol No.
	TEMPERATURE RISE TEST	1742 / 272012

QUANTIFICATION OF WINDING TEMPERATURE RISE

High-voltage winding



Low-voltage winding



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CYCLIC ENDURANCE TEST REPORT – HRN EN 50464-4

1. RATING VALUES OF TRANSFORMER TANK AND INITIAL PARAMETERS FOR THE TEST START

Customer:		BEZ Transformatory, Bratislava
Transformer tank serial no.		608 426/2
Oil weight:		150 kg
Tank oil temperature	T_0	28,9 °C
Initial oil volume in the tank	V_0	167 dm³
Volume expansion coefficient	α	0,00075 K^{-1} for mineral oil
Oil volume added to tank:	$\Delta V^+ = V_0\alpha(88-T_0)$	7,4 dm³
Oil volume extracted from tank:	$\Delta V^- = V_0\alpha(T_0+25)$	6,8 dm³
Max. allowed added oil volume after endurance test [3,0%]:		5 dm³

2. CYCLIC ENDURANCE TEST START

Date/time:	19.08.2016. 10:41
Intial oil height in the testing machine h_0:	327 mm
Intial oil volume in the testing machine V_u:	17,4 dm³
Pressure in relaxed tank state p_0:	1013 mbar
1 cycle duration:	123 s

3. CYCLIC ENDURANCE TEST FINISH

Date/time:	22.08.2016. 09:14
No. of cycles:	2000
Oil temperature at the end of the test T_z:	30,3 °C
Oil volume in testing machine after the test V_{u2}, Pressure level $p_z=p_0$	13,9 dm³
Oil volume added to the tank (to equal $p_z=p_0$, $V_{u1}-V_{u2}$)	3,5 dm³
Pressure in relaxed tank state at the end of the test p_z:	1013 mbar
Maximal pressure during the test p_{max}:	1182 mbar

4. STATIC LEAKAGE TEST

Test pressure pn=1,2 (pmax-p0) + P0	1216 mbar
Date/time @START:	22.08.2016. 09:55
Date/time @ END:	23.08.2016. 10:02
Test pressure @ START	1225 mbar
Test temperature @ START	29,9 °C
Test pressure @ END	1221 mbar
Test temperature @ END	28,5 °C

5. CONCLUSION

After the test under sections 3 and 4, distribution transformer tank has been visually inspected and no leakage or plastic deformation has been identified.

☒ TEST PASSED	☐ TEST NOT PASSED

	Tested performed and monitored by: Mladen ČAVLEK	Approved by: Josip VUGRINEC, ing. stroj. FEROKOTAO d.o.o. Donji Kraljevec
Issue date: 25.08.2016		Date: 25.08.2016

Document reference: QC.01-04LT

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CYCLIC ENDURANCE TEST REPORT – HRN EN 50464-4

1. RATING VALUES OF TRANSFORMER TANK AND INITIAL PARAMETERS FOR THE TEST START

Customer:		BEZ Transformatory, Bratislava
Transformer tank serial no.		609 971/2
Oil weight:		200 kg
Tank oil temperature	T_0	27,6 °C
Initial oil volume in the tank	V_0	223 dm³
Volume expansion coefficient	α	0,00075 K⁻¹ for mineral oil
Oil volume added to tank:	$\Delta V^+ = V_0\alpha(88-T_0)$	10,1 dm³
Oil volume extracted from tank:	$\Delta V^- = V_0\alpha(T_0+25)$	8,8 dm³
Max. allowed added oil volume after endurance test [3,0%]:		6,7 dm³

2. CYCLIC ENDURANCE TEST START

Date/time:	18.07.2016. 11:24
Intial oil height in the testing machine h_0:	378 mm
Intial oil volume in the testing machine V_u:	20,1 dm³
Pressure in relaxed tank state p_0:	1008 mbar
1 cycle duration:	122 s

3. CYCLIC ENDURANCE TEST FINISH

Date/time:	21.07.2016. 08:52
No. of cycles:	2000
Oil temperature at the end of the test T_z:	26,8 °C
Oil volume in testing machine after the test V_{u2}, Pressure level $p_z=p_0$	15,2 dm³
Oil volume added to the tank (to equal $p_z=p_0$, $V_{u1}-V_{u2}$)	4,9 dm³
Pressure in relaxed tank state at the end of the test p_z:	1008 mbar
Maximal pressure during the test p_{max}:	1207 mbar

4. STATIC LEAKAGE TEST

Test pressure pn=1,2 (pmax-p0) + P0	1247 mbar
Date/time @START:	21.07.2016. 10:24
Date/time @ END:	22.07.2016. 10:37
Test pressure @ START	1265 mbar
Test temperature @ START	27,3 °C
Test pressure @ END	1259 mbar
Test temperature @ END	26,9 °C

5. CONCLUSION

After the test under sections 3 and 4, distribution transformer tank has been visually inspected and no leakage or plastic deformation has been identified.

☒ TEST PASSED	☐ TEST NOT PASSED

	Tested performed and monitored by: Mladen ČAVLEK	Approved by: Josip VUGRINEC, ing. stroj.
Issue date: 25.07.2016		Date: 25.07.2016

FEROKOTAO d.o.o. Donji Kraljevec

Document reference: QC.01-04LT

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CYCLIC ENDURANCE TEST REPORT – HRN EN 50464-4

1. RATING VALUES OF TRANSFORMER TANK AND INITIAL PARAMETERS FOR THE TEST START

Customer:		BEZ Transformatory, Bratislava
Transformer tank serial no.		610 022/4
Oil weight:		210 kg
Tank oil temperature	T_0	25,8 °C
Initial oil volume in the tank	V_0	234 dm³
Volume expansion coefficient	α	0,00075 K^{-1} for mineral oil
Oil volume added to tank:	$\Delta V^{+}=V_0\alpha(88-T_0)$	10,9 dm³
Oil volume extracted from tank:	$\Delta V^{-}=V_0\alpha(T_0+25)$	8,7 dm³
Max. allowed added oil volume after endurance test [3,0%]:		7 dm³

2. CYCLIC ENDURANCE TEST START

Date/time:	08.08.2016. 11:09
Intial oil height in the testing machine h_0:	393 mm
Intial oil volume in the testing machine V_u:	20,9 dm³
Pressure in relaxed tank state p_0:	1007 mbar
1 cycle duration:	124 s

3. CYCLIC ENDURANCE TEST FINISH

Date/time:	11.08.2016. 09:38
No. of cycles:	2000
Oil temperature at the end of the test T_z:	21,6 °C
Oil volume in testing machine after the test V_{u2}, Pressure level $p_z=p_0$	15,5 dm³
Oil volume added to the tank (to equal $p_z=p_0$, $V_{u1}-V_{u2}$)	5,4 dm³
Pressure in relaxed tank state at the end of the test p_z:	1005 mbar
Maximal pressure during the test p_{max}:	1198 mbar

4. STATIC LEAKAGE TEST

Test pressure pn=1,2 (pmax-p0) + P0	1236 mbar
Date/time @START:	11.08.2016. 10:46
Date/time @ END:	12.08.2016. 10:54
Test pressure @ START	1211 mbar
Test temperature @ START	21,4 °C
Test pressure @ END	1208 mbar
Test temperature @ END	21,2 °C

5. CONCLUSION

After the test under sections 3 and 4, distribution transformer tank has been visually inspected and no leakage or plastic deformation has been identified.

☒ TEST PASSED ☐ TEST NOT PASSED

	Tested performed and monitored by: Mladen ČAVLEK	Approved by: FEROKOTAO d.o.o. Donji Kraljevec Josip VUGRINEC, ing. stroj.
Issue date: 15.08.2016		Date: 15.08.2016

Document reference: QC.01-04LT

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CYCLIC ENDURANCE TEST REPORT – HRN EN 50464-4

1. RATING VALUES OF TRANSFORMER TANK AND INITIAL PARAMETERS FOR THE TEST START

Customer:		BEZ Transformatory, Bratislava
Transformer tank serial no.		608 414/9
Oil weight:		350 kg
Tank oil temperature	T_0	20,8 °C
Initial oil volume in the tank	V_0	389 dm³
Volume expansion coefficient	α	0,00075 K⁻¹ for mineral oil
Oil volume added to tank:	$\Delta V^+ = V_0\alpha(88-T_0)$	19,6 dm³
Oil volume extracted from tank:	$\Delta V^- = V_0\alpha(T_0+25)$	13,4 dm³
Max. allowed added oil volume after endurance test [3,0%]:		11,7 dm³

2. CYCLIC ENDURANCE TEST START

Date/time:	16.05.2016. 09:23
Intial oil height in the testing machine h_0:	556 mm
Intial oil volume in the testing machine V_u:	29,6 dm³
Pressure in relaxed tank state p_0:	1009 mbar
1 cycle duration:	123 s

3. CYCLIC ENDURANCE TEST FINISH

Date/time:	19.05.2016. 08:48
No. of cycles:	2000
Oil temperature at the end of the test T_z:	21,4 °C
Oil volume in testing machine after the test V_{u2}, Pressure level $p_z=p_0$	21,4 dm³
Oil volume added to the tank (to equal $p_z=p_0$, $V_{u1}-V_{u2}$)	8,2 dm³
Pressure in relaxed tank state at the end of the test p_z:	1009 mbar
Maximal pressure during the test p_{max}:	1189 mbar

4. STATIC LEAKAGE TEST

Test pressure pn=1,2 (pmax-p0) + P0	1225 mbar
Date/time @START:	19.05.2016. 09:54
Date/time @ END:	20.05.2016. 10:06
Test pressure @ START	1241 mbar
Test temperature @ START	21,5 °C
Test pressure @ END	1237 mbar
Test temperature @ END	21,4 °C

5. CONCLUSION

After the test under sections 3 and 4, distribution transformer tank has been visually inspected and no leakage or plastic deformation has been identified.

☒ TEST PASSED ☐ TEST NOT PASSED

	Tested performed and monitored by: Mladen ČAVLEK	Approved by: FEROKOTAO d.o.o. Donji Kraljevec Josip VUGRINEC, ing. stroj.
Issue date: 23.05.2016		Date: 23.05.2016

Document reference: QC.01-04LT

Приложение № 7

Декларация за отсъствие на полихлорирани бифинили (PCB) в трансформаторното масло

BEZ TRANSFORMÁTORY, a.s.
member of ***International BEZ Group***
Rybničná 40, 835 54 Bratislava
Slovak Republic

Относно: **Клетвена декларация**

Производител: „БЕЗ ТРАНСФОРМАТОРИ“ АД
ул. „Рибнична“ № 40
835 54 Братислава
Република Словакия

Устройство: Трифазен маслен трансформатор херметичен тип без консерватор с медна намотка, произведен в съответствие със стандарт ČSN EN 60076

Пълнеж: Инхибирано трансформаторно масло от нафтенова суровина в съответствие със стандарт ČSN EN 60 296

„БЕЗ Трансформатори“ АД с настоящото декларира, че като изолационен и охлаждащ пълнеж за трансформатори използва инхибирано трансформаторно масло от нафтенова суровина с качества съгласно стандарт EN 60296. Този технически стандарт и спецификацията от производителя на трансформаторното масло декларират лимитите на съдържанието на ПХБ веществата по смисъла на IEC 61619 като неоткриваеми.

BEZ TRANSFORMÁTORY, a.s.
Rybničná 40
835 54 Bratislava
IČ DPH: SK2020337462
(1)

инж. Владимир Мах
Директор отдел „Развой“

Registered with the Commercial Register of District Court Bratislava I., Section Sa, Insert no. 760/B

Phone No.: +421 2 4961 1713
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Web: www.bez.sk

Company Identification No.: 31 383 475
VAT No.: SK2020337462

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Slovenská sporiteľňa, a.s. Bratislava
BIC – SWIFT: GIBASKBX
IBAN SK3409000000000177621814
acc.No.: 177 621 814/0900

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Приложение № 8

Протоколи от акредитирана лаборатория и сертификат/акредитация на лабораторията извършила проверката

Загуби на празен ход
Загуби на късо съединение при 75°C
Ниво на звукова мощност, L_{WA}

ETD TRANSFORMÁTORY a.s.
ELEKTROTECHNICKÁ ZKUŠEBNA
Zborovská 54/22, Doudlevce, 301 00 Plzeň, Czech Republic
tel.: +420 373 031 660, fax: +420 373 031 662, e-mail: info-ez@etd-bez.cz

L 1526

Total sheets: 5

Test Report

AP_EZ/2016/043/01/EN

Customer:	BEZ TRANSFORMÁTORY a.s. Rybničná 40 835 54 Bratislava
Tested object:	**Transformer TOHn 338/10, s.n. 0363131**
Test take over date:	September 23th , 2016
Test realization date:	September 27th , 2016
Test identification No.:	365-302-1624 **Evidentiary No:** 48/2016
Order No:	B06/4500006720

Testing methods, regulations:

ACCREDITED TESTS ACCORDING TO SOP_EZ/2, 4, 6 and 8:

ČSN EN 60076-1, Clause 11.2	Measurement of winding resistance
ČSN EN 60076-1, Clause 11.4	Measurement of short-circuit impedance and load loss
ČSN EN 60076-1, Clause 11.5	Measurement of no-load loss and current

Test results: In the text.

Enclosures: 1

AKREDITOVANÁ ELEKTROTECHNICKÁ ZKUŠEBNA L. 1526 ETD TRANSFORMÁTORY a.s.

In Plzeň, 30th September 2016

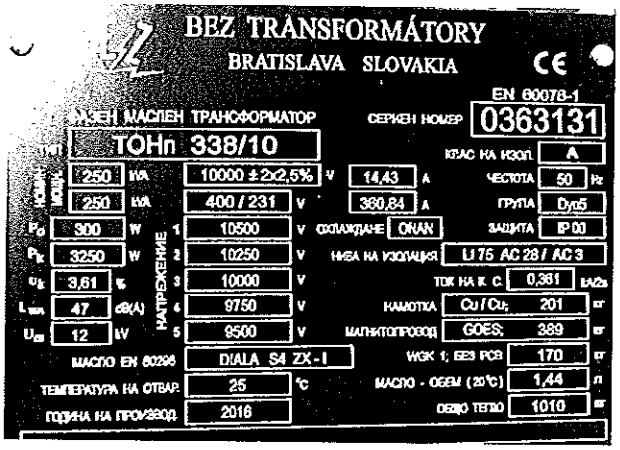
Petr Šíma
Electrical Testing Laboratory Director

Test Report is issued in 3 copies – 2 are obtained by the customer and 1 is kept in the Laboratory.
Test Report is issued for the customer in electronic form too.

Contents

Tested object

Oil-immersed transformer TOHn 338/10.



Performed tests

Routine tests:

- Measurement of winding resistance according to the Standard ČSN EN 60076-1, Clause 11. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of short-circuit impedance and load loss according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of no-load loss and current according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the switch P1 of the tested transformer.

Used apparatuses

Name	Type	Filing No.
Digital multimeter	Fluke 189	PMMm 263
Digital multimeter	Fluke 179	PMMm 269
Isolating converters	BB3652	PMMp 254
Digital thermometer	GMH 3710	PMMt 268
Current transformer	ABB Petercem EA100	PMTr 92
Current transformer	ABB Petercem EA100	PMTr 93
Current transformer	ABB Petercem EA100	PMTr 94

Measurement of winding resistance

Description

The measurement of winding resistance was performed according to the Standard ČSN EN 60076-1, Clause 11.2.3. Measurement was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Winding resistances each of above mentioned tappings were measured with DC current, with Ohm's method, between terminals of each phase on HV side of transformer and between node and terminal of respective phase on LV side of tested transformer. The mean temperature of cooling liquid (temperature of transformer winding) was measured during the test. Temperature was 22.1 °C. Resulting value of the resistance was recalculated to 75 °C.

Results

Resistances of transformer winding are noted in **Tab. 1.**

Side of transformer	Tap	Terminal	Before type and special tests	
			$R_{measured}$ (Ω)	R_{75} (Ω)
HV	1 (+ 5 %)	1U – 1V	4.327722706	5.218179848
		1U – 1W	4.409968642	5.317348421
		1V – 1W	4.296965870	5.181094593
	3 (0 %)	1U – 1V	4.052391875	4.886197905
		1U – 1W	4.103449421	4.947760873
		1V – 1W	4.033412094	4.863312909
	5 (- 5 %)	1U – 1V	3.870282471	4.666618304
		1U – 1W	3.846793231	4.638296000
		1V – 1W	3.803644329	4.586268931
LV		2n – 2u	0.002918685	0.003519223
		2n – 2v	0.002848058	0.003434065
		2n – 2w	0.002892835	0.003488055

Tab. 1: Resistances of transformer winding.

Measurement of short-circuit impedance and load loss

Description

Measurement of short-circuit impedance and load loss was performed according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Voltage was applied to HV terminals of the transformer, LV terminals were short circuited. Supply current of 50 Hz was ca. 9 A. Temperature was 22.3 °C.

Measured values of short-circuit impedance and load loss were corrected for the reference temperature 75 °C.

Results

Measured values of short-circuit impedance and load loss are noted in **Tab. 2.**

	Z a Δ P_k		
Tapping	1 (+ 5 %)	3 (0 %)	5 (- 5 %)
$Z_{measured}$ (Ω)	15.83	14.23	12.54
Z_{75} (Ω)	16.02	14.45	12.80
Δ $P_{k\ measured}$ (W)	2 089.44	2 494.65	2 992.39
Δ $P_{k\ 75}$ (W)	2 540.45	2 943.91	3 440.37

Tab. 2: Values of the short-circuit impedance and load loss.

Measurement of no-load loss and currents

Description

Measurement of no-load losses and currents was performed according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer in temperature steady state.

Supply voltage was applied to LV terminals of the transformer; HV terminals were no-loaded. Supply voltage during the measurement was set to 90 %, 100 % and 110 % of rated voltage U_2.

Results

Measured values of no-load losses and currents are noted in **tab. 3** and **4.**

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
Δ P_0 (W)	226.2	291.4	381.0

Tab. 3: Values of the no-load losses.

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
I_0 (A)	0.5192	0.7010	1.2956

Tab. 4: Values of the no-load currents.

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Olšanská 54/3, 130 00 Praha 3

issues

according to section 16 of Act No. 22/1997 Coll., on technical requirements for products, as amended

CERTIFICATE OF ACCREDITATION

No. 660 / 2015

ETD TRANSFORMÁTORY a.s.
with registered office Zborovská 54/22, 301 00 Plzeň, Company Registration No. 25137808

to the Testing Laboratory No. **1526**
ELECTRICAL TESTING LABORATORY

Scope of accreditation:

Electrical and air-handling testing and measuring of industrial equipment to the extent as specified in the appendix to this Certificate.

This Certificate of Accreditation is a proof of Accreditation issued on the basis of assessment of fulfillment of the accreditation criteria in accordance with

ČSN EN ISO/IEC 17025:2005

In its activities performed within the scope and for the period of validity of this Certificate, the Body is entitled to refer to this Certificate, provided that the accreditation is not suspended and the Body meets the specified accreditation requirements in accordance with the relevant regulations applicable to the activity of an accredited Conformity Assessment Body.

This Certificate of Accreditation replaces, to the full extent, Certificate No.: 474/2014 of 15 July 2014, or any administrative acts building upon it

The Certificate of Accreditation is valid until: **1 July 2018**

Prague: 21 September 2015

Jiří Růžička
Director
Czech Accreditation Institute
Public Service Company

Methods used in testing are specified in the Quality Manual of the Electrical Testing Laboratory and satisfy the precision requirements according to the respective standards. The presented test results are in relation to the subject of these tests only. The Test Report may be reproduced only as a whole.
In case of discrepancies the Czech version of the Test Report takes precedence.

ETD TRANSFORMÁTORY a.s.
ELEKTROTECHNICKÁ ZKUŠEBNA
Zborovská 54/22, Doudlevce, 301 00 Plzeň, Czech Republic
tel.: +420 373 031 660, fax: +420 373 031 662, e-mail: info-ez@etd-bez.cz

L 1526

Total sheets: 5

Test Report

AP_EZ/2016/044/01/EN

Customer:	BEZ TRANSFORMÁTORY a.s. Rybničná 40 835 54 Bratislava
Tested object:	**Transformer TOHn 358/10, s.n. 0363335**
Test take over date:	September 23th , 2016
Test realization date:	September 27th , 2016
Test identification No.:	365-302-1624 **Evidentiary No:** 48/2016
Order No:	B06/4500006720

Testing methods, regulations:

ACCREDITED TESTS ACCORDING TO SOP_EZ/2, 4, 6 and 8:

ČSN EN 60076-1, Clause 11.2	Measurement of winding resistance
ČSN EN 60076-1, Clause 11.4	Measurement of short-circuit impedance and load loss
ČSN EN 60076-1, Clause 11.5	Measurement of no-load loss and current

Test results: In the text.

Enclosures: 1

AKREDITOVANÁ ELEKTROTECHNICKÁ ZKUŠEBNA L. 1526 ETD TRANSFORMÁTORY a.s.

In Plzeň, 30th September 2016

Petr Šíma
Electrical Testing Laboratory Director

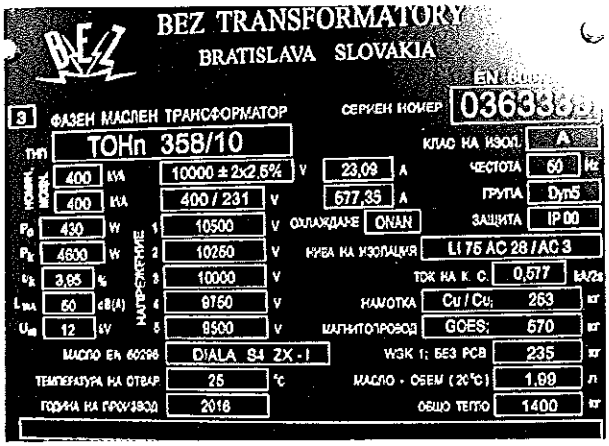
Test Report is issued in 3 copies – 2 are obtained by the customer and 1 is kept in the Laboratory.
Test Report is issued for the customer in electronic form too.

Methods used in testing are specified in the Quality Manual of the Electrical Testing Laboratory and satisfy the precision requirements according to the respective standards. The presented test results are in relation to the subject of these tests only. The Test Report may be reproduced only as a whole.
In case of discrepancies the Czech version of the Test Report takes precedence.

Contents

Tested object

Oil-immersed transformer TOHn 358/10.



Performed tests

Routine tests:

- Measurement of winding resistance according to the Standard ČSN EN 60076-1, Clause 11.2. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of short-circuit impedance and load loss according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of no-load loss and current according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer.

Used apparatuses

Name	Type	Filing No.
Digital multimeter	Fluke 189	PMMm 263
Digital multimeter	Fluke 179	PMMm 269
Isolating converters	BB3652	PMMp 254
Digital thermometer	GMH 3710	PMMt 268
Current transformer	ABB Petercem EA100	PMTr 92
Current transformer	ABB Petercem EA100	PMTr 93
Current transformer	ABB Petercem EA100	PMTr 94

Measurement of winding resistance

Description

The measurement of winding resistance was performed according to the Standard ČSN EN 60076-1, Clause 11.2.3. Measurement was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Winding resistances each of above mentioned tappings were measured with DC current, with Ohm's method, between terminals of each phase on HV side of transformer and between node and terminal of respective phase on LV side of tested transformer. The mean temperature of cooling liquid (temperature of transformer winding) was measured during the test. Temperature was 22.1 °C. Resulting value of the resistance was recalculated to 75 °C.

Results

Resistances of transformer winding are noted in **Tab. 1.**

Side of transformer	Tap	Terminal	Before type and special tests	
			$R_{measured}$ (Ω)	R_{75} (Ω)
HV	1 (+ 5 %)	1U – 1V	2.339262923	2.820581509
		1U – 1W	2.348953378	2.832265839
		1V – 1W	2.276971985	2.745473805
	3 (0 %)	1U – 1V	2.214036834	2.669589337
		1U – 1W	2.225141310	2.682978632
		1V – 1W	2.214905717	2.670636998
	5 (- 5 %)	1U – 1V	2.089617836	2.519570319
		1U – 1W	2.100680924	2.53290971
		1V – 1W	2.090954523	2.521182038
LV		2n – 2u	0.001879573	0.002266307
		2n – 2v	0.001884503	0.002272252
		2n – 2w	0.001922714	0.002318325

Tab. 1: Resistances of transformer winding.

Measurement of short-circuit impedance and load loss

Description

Measurement of short-circuit impedance and load loss was performed according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Voltage was applied to HV terminals of the transformer, LV terminals were short circuited. Supply current of 50 Hz was ca. 17 A. Temperature was 22.4 °C.

Measured values of short-circuit impedance and load loss were corrected for the reference temperature 75 °C.

Results

Measured values of short-circuit impedance and load loss are noted in **Tab. 2.**

	Z a Δ P_k		
Tapping	1 (+ 5 %)	3 (0 %)	5 (- 5 %)
$Z_{measured}$ (Ω)	10.98	9.76	8.71
Z_{75} (Ω)	11.08	9.88	8.84
Δ $P_{k\,measured}$ (W)	3 226.18	3 876.08	4 648.64
Δ $P_{k\,75}$ (W)	3 923.81	4 552.84	5 298.69

Tab. 2: Values of the short-circuit impedance and load loss.

Measurement of no-load loss and currents

Description

Measurement of no-load losses and currents was performed according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer in temperature steady state.

Supply voltage was applied to LV terminals of the transformer; HV terminals were no-loaded. Supply voltage during the measurement was set to 90 %, 100 % and 110 % of rated voltage U_2.

Results

Measured values of no-load losses and currents are noted in **tab. 3** and **4.**

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
Δ P_0 (W)	333.1	420.7	533.2

Tab. 3: Values of the no-load losses.

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
I_0 (A)	0.7923	0.9980	1.5766

Tab. 4: Values of the no-load currents.

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issues

according to section 16 of Act No. 22/1997 Coll., on technical requirements for products, as amended

CERTIFICATE OF ACCREDITATION

No. 660 / 2015

ETD TRANSFORMÁTORY a.s.
with registered office Zborovská 54/22, 301 00 Plzeň, Company Registration No. 25137808

to the Testing Laboratory No. 1526
ELECTRICAL TESTING LABORATORY

Scope of accreditation:

Electrical and air-handling testing and measuring of industrial equipment to the extent as specified in the appendix to this Certificate.

This Certificate of Accreditation is a proof of Accreditation issued on the basis of assessment of fulfillment of the accreditation criteria in accordance with

ČSN EN ISO/IEC 17025:2005

In its activities performed within the scope and for the period of validity of this Certificate, the Body is entitled to refer to this Certificate, provided that the accreditation is not suspended and the Body meets the specified accreditation requirements in accordance with the relevant regulations applicable to the activity of an accredited Conformity Assessment Body.

This Certificate of Accreditation replaces, to the full extent, Certificate No.: 474/2014 of 15 July 2014, or any administrative acts building upon it.

The Certificate of Accreditation is valid until: **1 July 2018**

Prague: 21 September 2015

Jiří Růžička
Director
Czech Accreditation Institute
Public Service Company

ETD TRANSFORMÁTORY a.s.
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Total sheets: 5

Test Report

AP_EZ/2016/045/01/EN

Customer:	BEZ TRANSFORMÁTORY a.s. Rybničná 40 835 54 Bratislava		
Tested object:	**Transformer TOHn 378/10, s.n. 0361503**		
Test take over date:	September 23th , 2016		
Test realization date:	September 27th , 2016		
Test identification No.:	365-302-1624	**Evidentiary No:**	48/2016
Order No:	B06/4500006720		

Testing methods, regulations:

ACCREDITED TESTS ACCORDING TO SOP_EZ/2, 4, 6 and 8:

ČSN EN 60076-1, Clause 11.2	Measurement of winding resistance
ČSN EN 60076-1, Clause 11.4	Measurement of short-circuit impedance and load loss
ČSN EN 60076-1, Clause 11.5	Measurement of no-load loss and current

Test results: In the text.

Enclosures: 1

In Plzeň, 30th September 2016

Petr Šíma
Electrical Testing Laboratory Director

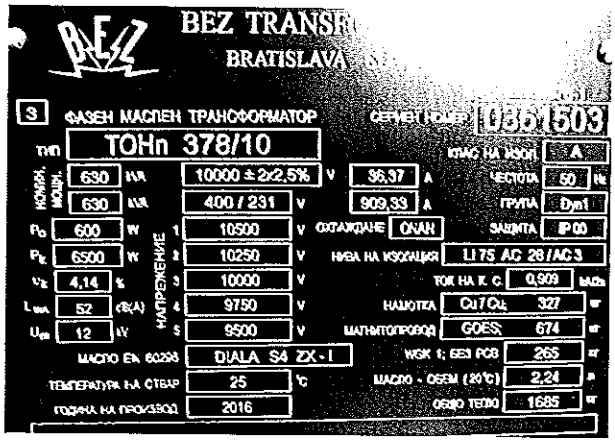
Test Report is issued in 3 copies – 2 are obtained by the customer and 1 is kept in the Laboratory.
Test Report is issued for the customer in electronic form too.

Methods used in testing are specified in the Quality Manual of the Electrical Testing Laboratory and satisfy the precision requirements according to the respective standards. The presented test results are in relation to the subject of these tests only. The Test Report may be reproduced only as a whole.
In case of discrepancies the Czech version of the Test Report takes precedence.

Contents

Tested object

Oil-immersed transformer TOHn 378/10.



Performed tests

Routine tests:

- Measurement of winding resistance according to the Standard ČSN EN 60076-1, Clause 11. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of short-circuit impedance and load loss according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of no-load loss and current according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer.

Used apparatuses

Name	Type	Filing No.
Digital multimeter	Fluke 189	PMMm 263
Digital multimeter	Fluke 179	PMMm 269
Isolating converters	BB3652	PMMp 254
Digital thermometer	GMH 3710	PMMt 268
Current transformer	ABB Petercem EA100	PMTr 92
Current transformer	ABB Petercem EA100	PMTr 93
Current transformer	ABB Petercem EA100	PMTr 94

Measurement of winding resistance

Description

The measurement of winding resistance was performed according to the Standard ČSN EN 60076-1, Clause 11.2.3. Measurement was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Winding resistances each of above mentioned tappings were measured with DC current, with Ohm's method, between terminals of each phase on HV side of transformer and between node and terminal of respective phase on LV side of tested transformer. The mean temperature of cooling liquid (temperature of transformer winding) was measured during the test. Temperature was 22.1 °C. Resulting value of the resistance was recalculated to 75 °C.

Results

Resistances of transformer winding are noted in **Tab. 1.**

Side of transformer	Tap	Terminal	Before type and special tests	
			$R_{measured}$ (Ω)	R_{75} (Ω)
HV	1 (+ 5 %)	1U – 1V	1.263367322	1.523906108
		1U – 1W	1.261630071	1.521810591
		1V – 1W	1.264324863	1.525061119
	3 (0 %)	1U – 1V	1.189650904	1.434987471
		1U – 1W	1.186356280	1.431013412
		1V – 1W	1.189263079	1.434519668
	5 (- 5 %)	1U – 1V	1.114140538	1.343904929
		1U – 1W	1.112359551	1.341756656
		1V – 1W	1.114562624	1.344414060
LV		2n – 2u	0.001058774	0.001276623
		2n – 2v	0.001091545	0.001316137
		2n – 2w	0.001083715	0.001306696

Tab. 1: Resistances of transformer winding.

Measurement of short-circuit impedance and load loss

Description

Measurement of short-circuit impedance and load loss was performed according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Voltage was applied to HV terminals of the transformer, LV terminals were short circuited. Supply current of 50 Hz was ca. 28 A. Temperature was 22.3 °C.

Measured values of short-circuit impedance and load loss were corrected for the reference temperature 75 °C.

Results

Measured values of short-circuit impedance and load loss are noted in **Tab. 2**.

	Z a Δ P_k		
Tapping	1 (+ 5 %)	3 (0 %)	5 (- 5 %)
$Z_{measured}$ (Ω)	7.29	6.52	5.73
Z_{75} (Ω)	7.33	6.57	5.79
Δ $P_{k\ measured}$ (W)	4 468.19	5 381.09	6 461.08
Δ $P_{k\ 75}$ (W)	5 427.18	6 308.32	7 356.14

Tab. 2: Values of the short-circuit impedance and load loss.

Measurement of no-load loss and currents

Description

Measurement of no-load losses and currents was performed according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer in temperature steady state.

Supply voltage was applied to LV terminals of the transformer; HV terminals were no-loaded. Supply voltage during the measurement was set to 90 %, 100 % and 110 % of rated voltage U_2.

Results

Measured values of no-load losses and currents are noted in **tab. 3** and **4**.

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
Δ P_0 (W)	444.2	691.4	799.9

Tab. 3: Values of the no-load losses.

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
I_0 (A)	1.3038	2.3427	7.1113

Tab. 4: Values of the no-load currents.

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issues

according to section 16 of Act No 22/1997 Coll., on technical requirements for products, as amended

CERTIFICATE OF ACCREDITATION

No. 660 / 2015

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to the Testing Laboratory No. 1526
ELECTRICAL TESTING LABORATORY

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Prague: 21 September 2015

Jiří Růžička
Director
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tel.: +420 373 031 660, fax: +420 373 031 662, e-mail: info-ez@etd-bez.cz

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Total sheets: 5

Test Report

AP_EZ/2016/046/01/EN

Customer:	BEZ TRANSFORMÁTORY a.s. Rybničná 40 835 54 Bratislava
Tested object:	**Transformer TOHn 388/10, s.n. 0361830**
Test take over date:	September 23th , 2016
Test realization date:	September 27th , 2016
Test identification No.:	365-302-1624 **Evidentiary No:** 48/2016
Order No:	B06/4500006720

Testing methods, regulations:

ACCREDITED TESTS ACCORDING TO SOP_EZ/2, 4, 6 and 8:

ČSN EN 60076-1, Clause 11.2	Measurement of winding resistance
ČSN EN 60076-1, Clause 11.4	Measurement of short-circuit impedance and load loss
ČSN EN 60076-1, Clause 11.5	Measurement of no-load loss and current

Test results: In the text.

Enclosures: 1

AKREDITOVANÁ ELEKTROTECHNICKÁ ZKUŠEBNA L 1526 ETD TRANSFORMÁTORY a.s.

In Plzeň, 30th September 2016

Petr Šíma
Electrical Testing Laboratory Director

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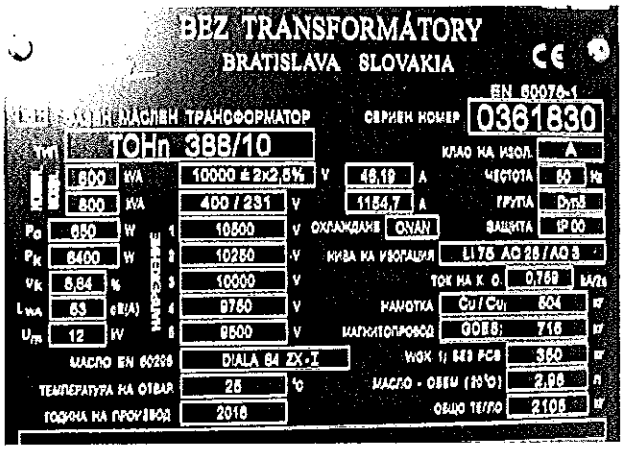
Contents

Tested object

Oil-immersed transformer TOHn 388/10.



Performed tests

Routine tests:

- Measurement of winding resistance according to the Standard ČSN EN 60076-1, Clause 11.2. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of short-circuit impedance and load loss according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of no-load loss and current according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer.

Used apparatuses

Name	Type	Filing No.
Digital multimeter	Fluke 189	PMMm 263
Digital multimeter	Fluke 179	PMMm 269
Isolating converters	BB3652	PMMp 254
Digital thermometer	GMH 3710	PMMt 268
Current transformer	ABB Petercem EA100	PMTr 92
Current transformer	ABB Petercem EA100	PMTr 93
Current transformer	ABB Petercem EA100	PMTr 94

Measurement of winding resistance

Description

The measurement of winding resistance was performed according to the Standard ČSN EN 60076-1, Clause 11.2.3. Measurement was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Winding resistances each of above mentioned tappings were measured with DC current, with Ohm's method, between terminals of each phase on HV side of transformer and between node and terminal of respective phase on LV side of tested transformer. The mean temperature of cooling liquid (temperature of transformer winding) was measured during the test. Temperature was 22.0 °C. Resulting value of the resistance was recalculated to 75 °C.

Results

Resistances of transformer winding are noted in **Tab. 1.**

Side of transformer	Tap	Terminal	Before type and special tests	
			$R_{measured}$ (Ω)	R_{75} (Ω)
HV	1 (+ 5 %)	1U – 1V	0.977786593	1.179431298
		1U – 1W	0.976430976	1.177796119
		1V – 1W	0.978841210	1.180703405
	3 (0 %)	1U – 1V	0.920135431	1.109890987
		1U – 1W	0.919654385	1.109310736
		1V – 1W	0.920154348	1.109913806
	5 (- 5 %)	1U – 1V	0.864955910	1.043332032
		1U – 1W	0.864148311	1.042357884
		1V – 1W	0.863237640	1.041259410
LV		2n – 2u	0.000791778	0.000955063
		2n – 2v	0.000788484	0.000951089
		2n – 2w	0.000770467	0.000929358

Tab. 1: Resistances of transformer winding.

Measurement of short-circuit impedance and load loss

Description

Measurement of short-circuit impedance and load loss was performed according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Voltage was applied to HV terminals of the transformer, LV terminals were short circuited. Supply current of 50 Hz was ca. 32 A. Temperature was 22.2 °C.

Measured values of short-circuit impedance and load loss were corrected for the reference temperature 75 °C.

Results

Measured values of short-circuit impedance and load loss are noted in **Tab. 2.**

	Z a ΔP_k		
Tapping	1 (+ 5 %)	3 (0 %)	5 (- 5 %)
$Z_{measured}$ (Ω)	8.23	7.25	6.71
Z_{75} (Ω)	8.25	7.28	6.74
$\Delta P_{k\ measured}$ (W)	5 580.66	6 685.41	8 050.91
$\Delta P_{k\ 75}$ (W)	6 700.98	7 827.49	9 088.76

Tab. 2: Values of the short-circuit impedance and load loss.

Measurement of no-load loss and currents

Description

Measurement of no-load losses and currents was performed according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer in temperature steady state.

Supply voltage was applied to LV terminals of the transformer; HV terminals were no-loaded. Supply voltage during the measurement was set to 90 %, 100 % and 110 % of rated voltage U_2.

Results

Measured values of no-load losses and currents are noted in **tab. 3** and **4.**

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
ΔP_0 (W)	471.0	647.2	867.8

Tab. 3: Values of the no-load losses.

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
I_0 (A)	1.3013	2.3207	7.0910

Tab. 4: Values of the no-load currents.

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CERTIFICATE OF ACCREDITATION

No. 660 / 2015

ETD TRANSFORMÁTORY a.s.
with registered office Zborovská 54/22, 301 00 Plzeň, Company Registration No. 25137808

to the Testing Laboratory No. 1526
ELECTRICAL TESTING LABORATORY

Scope of accreditation:

Electrical and air-handling testing and measuring of industrial equipment to the extent as specified in the appendix to this Certificate.

This Certificate of Accreditation is a proof of Accreditation issued on the basis of assessment of fulfillment of the accreditation criteria in accordance with

ČSN EN ISO/IEC 17025:2005

In its activities performed within the scope and for the period of validity of this Certificate, the Body is entitled to refer to this Certificate, provided that the accreditation is not suspended and the Body meets the specified accreditation requirements in accordance with the relevant regulations applicable to the activity of an accredited Conformity Assessment Body.

This Certificate of Accreditation replaces, to the full extent, Certificate No.: 474/2014 of 15 July 2014, or any administrative acts building upon it.

The Certificate of Accreditation is valid until: **1 July 2018**

Prague: 21 September 2015

Jiří Růžička
Director
Czech Accreditation Institute
Public Service Company

Methods used in testing are specified in the Quality Manual of the Electrical Testing Laboratory and satisfy the precision requirements according to the respective standards. The presented test results are in relation to the subject of these tests only. The Test Report may be reproduced only as a whole.
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ETD TRANSFORMÁTORY a.s.
ELEKTROTECHNICKÁ ZKUŠEBNA
Zborovská 54/22, Doudlevce, 301 00 Plzeň, Czech Republic
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L 1526

Total sheets: 5

Test Report

AP_EZ/2016/041/01/EN

Customer:	BEZ TRANSFORMÁTORY a.s. Rybničná 40 835 54 Bratislava		
Tested object:	**Transformer TOHn 269/22, s.n. 0362480**		
Test take over date:	September 23th , 2016		
Test realization date:	September 26th , 2016		
Test identification No.:	365-302-1624	**Evidentiary No:**	48/2016
Order No:	B06/4500006720		

Testing methods, regulations:

ACCREDITED TESTS ACCORDING TO SOP_EZ/2, 4, 6 and 8:

ČSN EN 60076-1, Clause 11.2	Measurement of winding resistance
ČSN EN 60076-1, Clause 11.4	Measurement of short-circuit impedance and load loss
ČSN EN 60076-1, Clause 11.5	Measurement of no-load loss and current

Test results: In the text.

Enclosures: 1

ZKUŠEBNA ELEKTROTECHNICKÁ AKREDITOVANÁ L. 1526 ETD TRANSFORMÁTORY a.s.

In Plzeň, 30th September 2016

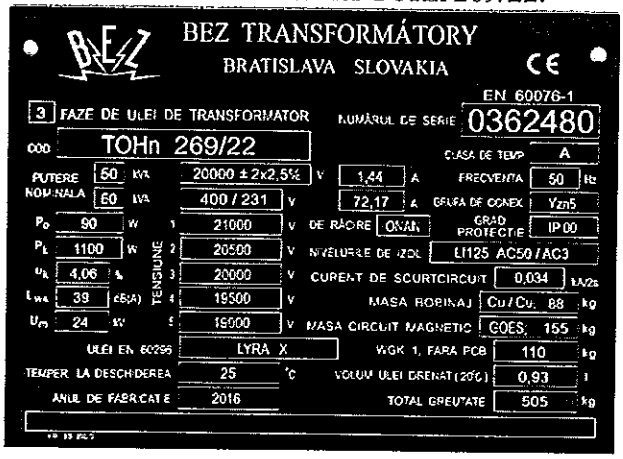
Petr Šíma
Electrical Testing Laboratory Director

Test Report is issued in 3 copies – 2 are obtained by the customer and 1 is kept in the Laboratory.
Test Report is issued for the customer in electronic form too.

Contents

Tested object

Oil-immersed transformer TOHn 269/22.



Performed tests

Routine tests:

- Measurement of winding resistance according to the Standard ČSN EN 60076-1, Clause 11(The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of short-circuit impedance and load loss according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of no-load loss and current according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the switch P1 of the tested transformer.

Used apparatuses

Name	Type	Filing No.
Digital multimeter	Fluke 189	PMMm 263
Digital multimeter	Fluke 179	PMMm 269
Isolating converters	BB3652	PMMp 254
Digital thermometer	GMH 3710	PMMt 268
Current transformer	ABB Petercem EA100	PMTr 92
Current transformer	ABB Petercem EA100	PMTr 93
Current transformer	ABB Petercem EA100	PMTr 94

Measurement of winding resistance

Description

The measurement of winding resistance was performed according to the Standard ČSN EN 60076-1, Clause 11.2.3. Measurement was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Winding resistances each of above mentioned tappings were measured with DC current, with Ohm's method, between terminals of each phase on HV side of transformer and between node and terminal of respective phase on LV side of tested transformer. The mean temperature of cooling liquid (temperature of transformer winding) was measured during the test. Temperature was between 22.3 °C and 22.6 °C. Resulting value of the resistance was recalculated to 75 °C.

Results

Resistances of transformer winding are noted in **Tab. 1.**

Side of transformer	Tap	Terminal	Before type and special tests	
			$R_{measured}$ (Ω)	R_{75} (Ω)
HV	1 (+ 5 %)	1U – 1V	137.2851789	167.4879182
		1U – 1W	137.3936772	167.6202862
		1V – 1W	137.3279432	167.5400907
	3 (0 %)	1U – 1V	130.7847531	159.5573987
		1U – 1W	130.8511212	159.6383678
		1V – 1W	130.8079614	159.5877129
	5 (- 5 %)	1U – 1V	124.1509867	151.4642037
		1U – 1W	124.3085651	151.6564494
		1V – 1W	124.2674901	151.6063379
LV		2n – 2u	0.05179086	0.063184849
		2n – 2v	0.05340874	0.065158662
		2n – 2w	0.05268132	0.064271210

Tab. 1: Resistances of transformer winding.

Measurement of short-circuit impedance and load loss

Description

Measurement of short-circuit impedance and load loss was performed according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Voltage was applied to HV terminals of the transformer, LV terminals were short circuited. Supply current of 50 Hz was ca. 1 A. Temperature was 22.5 °C.

Measured values of short-circuit impedance and load loss were corrected for the reference temperature 75 °C.

Results

Measured values of short-circuit impedance and load loss are noted in **Tab. 2.**

	Z a Δ P_k		
Tapping	1 (+ 5 %)	3 (0 %)	5 (- 5 %)
$Z_{measured}$ (Ω)	242.11	215.84	194.80
Z_{75} (Ω)	295.37	263.32	237.66
Δ $P_{k\ measured}$ (W)	812.21	854.96	897.70
Δ $P_{k\ 75}$ (W)	990.89	1 028.04	1 079.44

Tab. 2: Values of the short-circuit impedance and load loss.

Measurement of no-load loss and currents

Description

Measurement of no-load losses and currents was performed according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer in temperature steady state.

Supply voltage was applied to LV terminals of the transformer; HV terminals were no-loaded. Supply voltage during the measurement was set to 90 %, 100 % and 110 % of rated voltage U_2.

Results

Measured values of no-load losses and currents are noted in **tab. 3** and **4.**

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
Δ P_0 (W)	76.86	85.4	93.94

Tab. 3: Values of the no-load losses.

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
I_0 (A)	0.331	0.368	0.404

Tab. 4: Values of the no-load currents.

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CERTIFICATE OF ACCREDITATION

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The Certificate of Accreditation is valid until: **1 July 2018**

Prague: 21 September 2015

Jiří Růžička
Director
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Total sheets: 5

Test Report

AP_EZ/2016/042/01/EN

Customer:	BEZ TRANSFORMÁTORY a.s. Rybničná 40 835 54 Bratislava
Tested object:	**Transformer TOHn 299/22, s.n. 0362640**
Test take over date:	September 23th , 2016
Test realization date:	September 26th , 2016
Test identification No.:	365-302-1624 **Evidentiary No:** 48/2016
Order No:	B06/4500006720

Testing methods, regulations:

ACCREDITED TESTS ACCORDING TO SOP_EZ/2, 4, 6 and 8:

ČSN EN 60076-1, Clause 11.2	Measurement of winding resistance
ČSN EN 60076-1, Clause 11.4	Measurement of short-circuit impedance and load loss
ČSN EN 60076-1, Clause 11.5	Measurement of no-load loss and current

Test results: In the text.

Enclosures: 1

AKREDITOVANÁ ELEKTROTECHNICKÁ ZKUŠEBNA L. 1526 ETD TRANSFORMÁTORY a.s.

In Plzeň, 30th September 2016

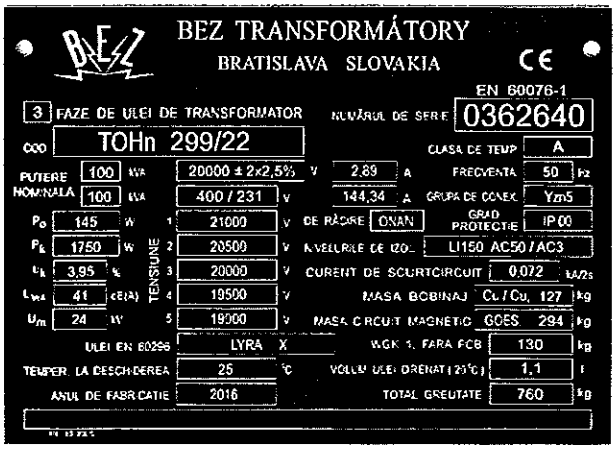
Petr Šíma
Electrical Testing Laboratory Director

Test Report is issued in 3 copies – 2 are obtained by the customer and 1 is kept in the Laboratory.
Test Report is issued for the customer in electronic form too.

Contents

Tested object

Oil-immersed transformer TOHn 299/22.



Performed tests

Routine tests:

- Measurement of winding resistance according to the Standard ČSN EN 60076-1, Clause 11.2. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of short-circuit impedance and load loss according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of no-load loss and current according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the switch P1 of the tested transformer.

Used apparatuses

Name	Type	Filing No.
Digital multimeter	Fluke 189	PMMm 263
Digital multimeter	Fluke 179	PMMm 269
Isolating converters	BB3652	PMMp 254
Digital thermometer	GMH 3710	PMMt 268
Current transformer	ABB Petercem EA100	PMTr 92
Current transformer	ABB Petercem EA100	PMTr 93
Current transformer	ABB Petercem EA100	PMTr 94

Measurement of winding resistance

Description

The measurement of winding resistance was performed according to the Standard ČSN EN 60076-1, Clause 11.2.3. Measurement was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Winding resistances each of above mentioned tappings were measured with DC current, with Ohm's method, between terminals of each phase on HV side of transformer and between node and terminal of respective phase on LV side of tested transformer. The mean temperature of cooling liquid (temperature of transformer winding) was measured during the test. Temperature was between 22.1 °C and 22.5 °C. Resulting value of the resistance was recalculated to 75 °C.

Results

Resistances of transformer winding are noted in **Tab. 1.**

Side of transformer	Tap	Terminal	Before type and special tests	
			$R_{measured}$ (Ω)	R_{75} (Ω)
HV	1 (+ 5 %)	1U – 1V	51.73159043	63.11254032
		1U – 1W	51,93312335	63.35841049
		1V – 1W	51.62890456	62.98726356
	3 (0 %)	1U – 1V	54.61298768	67.84784496
		1U – 1W	54.66644564	66.69306363
		1V – 1W	54.60578633	66.61905932
	5 (- 5 %)	1U – 1V	57.34690543	69.96322462
		1U – 1W	57.39976792	70.02771686
		1V – 1W	57.33795321	69.95230291
LV		2n – 2u	0.019213564	0.0234405480
		2n – 2v	0.019099928	0.0233019121
		2n – 2w	0.019157943	0.0233726904

Tab. 1: Resistances of transformer winding.

Measurement of short-circuit impedance and load loss

Description

Measurement of short-circuit impedance and load loss was performed according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Voltage was applied to HV terminals of the transformer, LV terminals were short circuited. Supply current of 50 Hz was ca. 3 A. Temperature was 22.6 °C.

Measured values of short-circuit impedance and load loss were corrected for the reference temperature 75 °C.

Results

Measured values of short-circuit impedance and load loss are noted in **Tab. 2.**

	Z a Δ P_k		
Tapping	1 (+ 5 %)	3 (0 %)	5 (- 5 %)
$Z_{measured}$ (Ω)	186.24	166.03	149.85
Z_{75} (Ω)	227.21	128.61	116.53
Δ $P_{k\ measured}$ (W)	1 264.14	1 330.68	1 397.21
Δ $P_{k\ 75}$ (W)	1 517.95	1 597.85	1 677.74

Tab. 2: Values of the short-circuit impedance and load loss.

Measurement of no-load loss and currents

Description

Measurement of no-load losses and currents was performed according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer in temperature steady state.

Supply voltage was applied to LV terminals of the transformer; HV terminals were no-loaded. Supply voltage during the measurement was set to 90 %, 100 % and 110 % of rated voltage U_2.

Results

Measured values of no-load losses and currents are noted in **tab. 3** and **4.**

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
Δ P_0 (W)	129.24	143.6	157.96

Tab. 3: Values of the no-load losses.

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
I_0 (A)	0.383	0.426	0.468

Tab. 4: Values of the no-load currents.

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CERTIFICATE OF ACCREDITATION

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to the Testing Laboratory No. 1526
ELECTRICAL TESTING LABORATORY

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Prague: 21 September 2015

Jiří Růžička
Director
Czech Accreditation Institute
Public Service Company

-2-

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tel.: +420 373 031 660, fax: +420 373 031 662, e-mail: info-ez@etd-bez.cz

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Total sheets: 5

Test Report

AP_EZ/2016/047/01/EN

Customer:	BEZ TRANSFORMÁTORY a.s. Rybničná 40 835 54 Bratislava		
Tested object:	**Transformer TOHn 319/22, s.n. 0361960**		
Test take over date:	September 23th , 2016		
Test realization date:	September 26th , 2016		
Test identification No.:	365-302-1624	**Evidentiary No:**	48/2016
Order No:	B06/4500006720		

Testing methods, regulations:

ACCREDITED TESTS ACCORDING TO SOP_EZ/2, 4, 6 and 8:

ČSN EN 60076-1, Clause 11.2	Measurement of winding resistance
ČSN EN 60076-1, Clause 11.4	Measurement of short-circuit impedance and load loss
ČSN EN 60076-1, Clause 11.5	Measurement of no-load loss and current

Test results: In the text.

Enclosures: 1

AKREDITOVANÁ ELEKTROTECHNICKÁ ZKUŠEBNA L 1526 ETD TRANSFORMÁTORY a.s.

In Plzeň, 30th September 2016

Petr Šíma
Electrical Testing Laboratory Director

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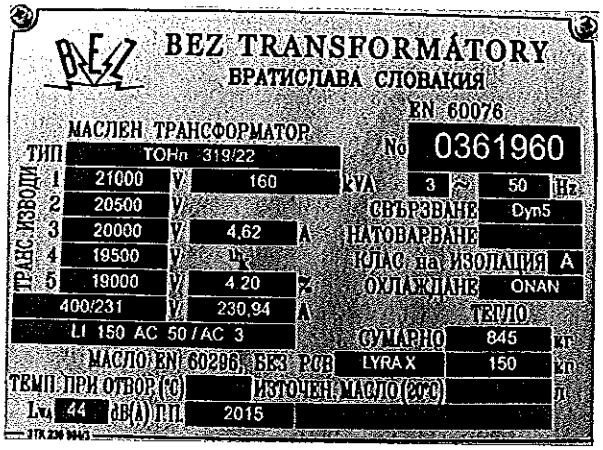
Contents

Tested object

Oil-immersed transformer TOHn 319/22.



Performed tests

Routine tests:

- Measurement of winding resistance according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of short-circuit impedance and load loss according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of no-load loss and current according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the switch P1 of the tested transformer.

Used apparatuses

Name	Type	Filing No.
Digital multimeter	Fluke 189	PMMm 263
Digital multimeter	Fluke 179	PMMm 269
Isolating converters	BB3652	PMMp 254
Digital thermometer	GMH 3710	PMMt 268
Current transformer	ABB Petercem EA100	PMTr 92
Current transformer	ABB Petercem EA100	PMTr 93
Current transformer	ABB Petercem EA100	PMTr 94

Measurement of winding resistance

Description

The measurement of winding resistance was performed according to the Standard ČSN EN 60076-1, Clause 11.2.3. Measurement was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Winding resistances each of above mentioned tappings were measured with DC current, with Ohm's method, between terminals of each phase on HV side of transformer and between node and terminal of respective phase on LV side of tested transformer. The mean temperature of cooling liquid (temperature of transformer winding) was measured during the test. Temperature was between 22.2 °C and 22.7 °C. Resulting value of the resistance was recalculated to 75 °C.

Results

Resistances of transformer winding are noted in **Tab. 1.**

Side of transformer	Tap	Terminal	Before type and special tests	
			$R_{measured}$ (Ω)	R_{75} (Ω)
HV	1 (+ 5 %)	1U – 1V	36.53001464	44.02917783
		1U – 1W	36.60274932	44.13853922
		1V – 1W	36.58698981	44.08071062
	3 (0 %)	1U – 1V	34.60412508	41.70792681
		1U – 1W	34.71354513	41.83980945
		1V – 1W	34.68085106	41.78415791
	5 (- 5 %)	1U – 1V	32.73462354	39.45463957
		1U – 1W	32.81904635	39.54101970
		1V – 1W	32.79462623	39.51159787
LV		2n – 2u	0.004330360	0.005209203
		2n – 2v	0.004199683	0.005052005
		2n – 2w	0.004212380	0.005067280

Tab. 1: Resistances of transformer winding.

Measurement of short-circuit impedance and load loss

Description

Measurement of short-circuit impedance and load loss was performed according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Voltage was applied to HV terminals of the transformer, LV terminals were short circuited. Supply current of 50 Hz was ca. 3 A. Temperature was 22.6 °C.

Measured values of short-circuit impedance and load loss were corrected for the reference temperature 75 °C.

Results

Measured values of short-circuit impedance and load loss are noted in **Tab. 2.**

	Z a Δ P_k		
Tapping	1 (+ 5 %)	3 (0 %)	5 (- 5 %)
$Z_{measured}$ (Ω)	116.40	103.77	93.66
Z_{75} (Ω)	117.86	105.42	95.52
Δ $P_{k\ measured}$ (W)	1 574.43	1 864.00	2 216.87
Δ $P_{k\ 75}$ (W)	1 914.73	2 210.48	2 574.23

Tab. 2: Values of the short-circuit impedance and load loss.

Measurement of no-load loss and currents

Description

Measurement of no-load losses and currents was performed according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer in temperature steady state.

Supply voltage was applied to LV terminals of the transformer; HV terminals were no-loaded. Supply voltage during the measurement was set to 90 %, 100 % and 110 % of rated voltage U_2.

Results

Measured values of no-load losses and currents are noted in **tab. 3** and **4.**

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
Δ P_0 (W)	160.2	203.0	264.1

Tab. 3: Values of the no-load losses.

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
I_0 (A)	0.6932	0.7421	0.8351

Tab. 4: Values of the no-load currents.

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This Certificate of Accreditation replaces, to the full extent, Certificate No.: 474/2014 of 15 July 2014, or any administrative acts building upon it

The Certificate of Accreditation is valid until: **1 July 2018**

Prague: 21 September 2015

Jiří Růžička
Director
Czech Accreditation Institute
Public Service Company

ETD TRANSFORMÁTORY a.s.
ELEKTROTECHNICKÁ ZKUŠEBNA
Zborovská 54/22, Doudlevce, 301 00 Plzeň, Czech Republic
tel.: +420 373 031 660, fax: +420 373 031 662, e-mail: info-ez@etd-bez.cz

ilac-MRA

L 1526

Total sheets: 5

Test Report

AP_EZ/2016/048/01/EN

Customer:	BEZ TRANSFORMÁTORY a.s. Rybničná 40 835 54 Bratislava
Tested object:	**Transformer TOHn 339/22, s.n. 0363132**
Test take over date:	September 23th , 2016
Test realization date:	September 27th , 2016
Test identification No.:	365-302-1624 **Evidentiary No:** 48/2016
Order No:	B06/4500006720

Testing methods, regulations:

ACCREDITED TESTS ACCORDING TO SOP_EZ/2, 4, 6 and 8:

ČSN EN 60076-1, Clause 11.2	Measurement of winding resistance
ČSN EN 60076-1, Clause 11.4	Measurement of short-circuit impedance and load loss
ČSN EN 60076-1, Clause 11.5	Measurement of no-load loss and current

Test results: In the text.

Enclosures: 1

AKREDITOVANÁ ELEKTROTECHNICKÁ ZKUŠEBNA L 1526 ETD TRANSFORMÁTORY a.s.

In Plzeň, 30th September 2016

Petr Šíma
Electrical Testing Laboratory Director

Test Report is issued in 3 copies – 2 are obtained by the customer and 1 is kept in the Laboratory.
Test Report is issued for the customer in electronic form too.

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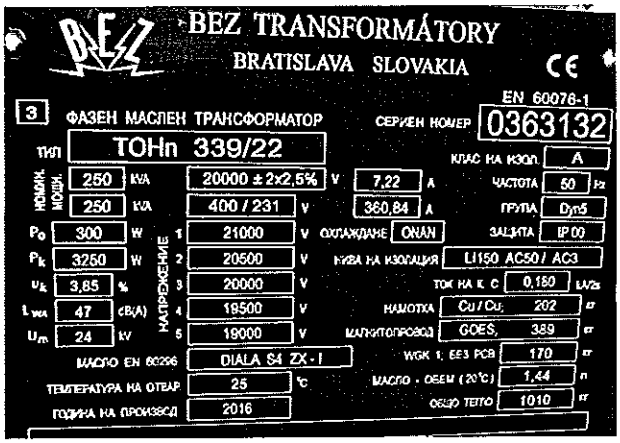
Contents

Tested object

Oil-immersed transformer TOHn 339/22.



Performed tests

Routine tests:

- Measurement of winding resistance according to the Standard ČSN EN 60076-1, Clause 11.2. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of short-circuit impedance and load loss according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of no-load loss and current according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the switch P1 of the tested transformer.

Used apparatuses

Name	Type	Filing No.
Digital multimeter	Fluke 189	PMMm 263
Digital multimeter	Fluke 179	PMMm 269
Isolating converters	BB3652	PMMp 254
Digital thermometer	GMH 3710	PMMt 268
Current transformer	ABB Petercem EA100	PMTr 92
Current transformer	ABB Petercem EA100	PMTr 93
Current transformer	ABB Petercem EA100	PMTr 94

Measurement of winding resistance

Description

The measurement of winding resistance was performed according to the Standard ČSN EN 60076-1, Clause 11.2.3. Measurement was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Winding resistances each of above mentioned tappings were measured with DC current, with Ohm's method, between terminals of each phase on HV side of transformer and between node and terminal of respective phase on LV side of tested transformer. The mean temperature of cooling liquid (temperature of transformer winding) was measured during the test. Temperature was between 20.3 °C and 20.8 °C. Resulting value of the resistance was recalculated to 75 °C.

Results

Resistances of transformer winding are noted in **Tab. 1.**

Side of transformer	Tap	Terminal	Before type and special tests	
			$R_{measured}$ (Ω)	R_{75} (Ω)
HV	1 (+ 5 %)	1U – 1V	16.90893651	20.53180697
		1U – 1W	16.91363568	20.53751297
		1V – 1W	16.91245841	20.53608346
	3 (0 %)	1U – 1V	16.01939321	19.45167213
		1U – 1W	16.02375368	19.45696687
		1V – 1W	16.02209945	19.45495820
	5 (- 5 %)	1U – 1V	15.12940941	18.37100242
		1U – 1W	15.15136377	18.39766067
		1V – 1W	15.13416638	18.37677860
LV		2n – 2u	0.002906887	0.003522810
		2n – 2v	0.002966337	0.003594858
		2n – 2w	0.002989680	0.003623147

Tab. 1: Resistances of transformer winding.

Measurement of short-circuit impedance and load loss

Description

Measurement of short-circuit impedance and load loss was performed according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Voltage was applied to HV terminals of the transformer, LV terminals were short circuited. Supply current of 50 Hz was ca. 4 A. Temperature was 21.4 °C.

Measured values of short-circuit impedance and load loss were corrected for the reference temperature 75 °C.

Results

Measured values of short-circuit impedance and load loss are noted in **Tab. 2.**

	Z a Δ P_k		
Tapping	1 (+ 5 %)	3 (0 %)	5 (- 5 %)
$Z_{measured}$ (Ω)	68.26	63.18	54.22
Z_{75} (Ω)	68.98	63.99	55.22
Δ $P_{k\,measured}$ (W)	2 088.47	2 496.51	2 986.57
Δ $P_{k\,75}$ (W)	2 559.12	2 963.11	3 444.16

Tab. 2: Values of the short-circuit impedance and load loss.

Measurement of no-load loss and currents

Description

Measurement of no-load losses and currents was performed according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer in temperature steady state.

Supply voltage was applied to LV terminals of the transformer; HV terminals were no-loaded. Supply voltage during the measurement was set to 90 %, 100 % and 110 % of rated voltage U_2.

Results

Measured values of no-load losses and currents are noted in **tab. 3** and **4.**

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
Δ P_0 (W)	234.1	298.5	393.8

Tab. 3: Values of the no-load losses.

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
I_0 (A)	1.0170	1.0760	1.2970

Tab. 4: Values of the no-load currents.

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Olšanská 54/3, 130 00 Praha 3

issues

according to section 16 of Act No. 22/1997 Coll., on technical requirements for products, as amended

CERTIFICATE OF ACCREDITATION

No. 660 / 2015

ETD TRANSFORMÁTORY a.s.
with registered office Zborovská 54/22, 301 00 Plzeň, Company Registration No. 25137808

to the Testing Laboratory No. 1526
ELECTRICAL TESTING LABORATORY

Scope of accreditation:

Electrical and air-handling testing and measuring of industrial equipment to the extent as specified in the appendix to this Certificate.

This Certificate of Accreditation is a proof of Accreditation issued on the basis of assessment of fulfilment of the accreditation criteria in accordance with

ČSN EN ISO/IEC 17025:2005

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Prague: 21 September 2015

Jiří Růžička
Director
Czech Accreditation Institute
Public Service Company

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ETD TRANSFORMÁTORY a.s.
ELEKTROTECHNICKÁ ZKUŠEBNA
Zborovská 54/22, Doudlevce, 301 00 Plzeň, Czech Republic
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L 1526

Total sheets: 5

Test Report

AP_EZ/2016/049/01/EN

Customer:	BEZ TRANSFORMÁTORY a.s. Rybničná 40 835 54 Bratislava
Tested object:	**Transformer TOHn 359/22, s.n. 0363336**
Test take over date:	September 23th , 2016
Test realization date:	September 26th , 2016
Test identification No.:	365-302-1624 **Evidentiary No:** 48/2016
Order No:	B06/4500006720

Testing methods, regulations:

ACCREDITED TESTS ACCORDING TO SOP_EZ/2, 4, 6 and 8:

ČSN EN 60076-1, Clause 11.2	Measurement of winding resistance
ČSN EN 60076-1, Clause 11.4	Measurement of short-circuit impedance and load loss
ČSN EN 60076-1, Clause 11.5	Measurement of no-load loss and current

Test results: In the text.

Enclosures: 1

In Plzeň, 30th September 2016

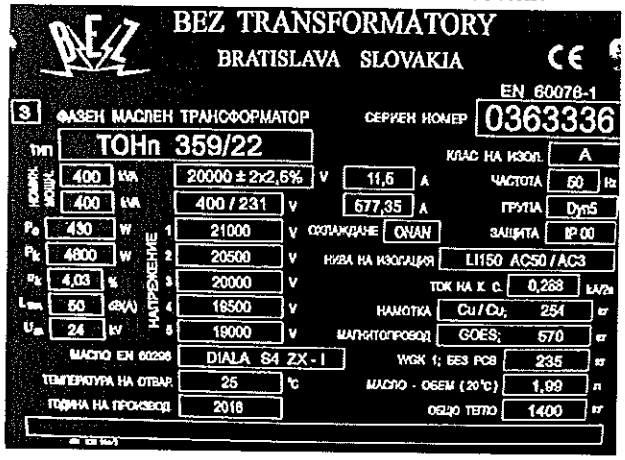
Petr Šíma
Electrical Testing Laboratory Director

Test Report is issued in 3 copies – 2 are obtained by the customer and 1 is kept in the Laboratory.
Test Report is issued for the customer in electronic form too.

Contents

Tested object

Oil-immersed transformer TOHn 359/22.



Performed tests

Routine tests:

- Measurement of winding resistance according to the Standard ČSN EN 60076-1, Clause 11. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of short-circuit impedance and load loss according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of no-load loss and current according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer.

Used apparatuses

Name	Type	Filing No.
Digital multimeter	Fluke 189	PMMm 263
Digital multimeter	Fluke 179	PMMm 269
Isolating converters	BB3652	PMMp 254
Digital thermometer	GMH 3710	PMMt 268
Current transformer	ABB Petercem EA100	PMTr 92
Current transformer	ABB Petercem EA100	PMTr 93
Current transformer	ABB Petercem EA100	PMTr 94

Measurement of winding resistance

Description

The measurement of winding resistance was performed according to the Standard ČSN EN 60076-1, Clause 11.2.3. Measurement was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Winding resistances each of above mentioned tappings were measured with DC current, with Ohm's method, between terminals of each phase on HV side of transformer and between node and terminal of respective phase on LV side of tested transformer. The mean temperature of cooling liquid (temperature of transformer winding) was measured during the test. Temperature was between 22.3 °C and 22.7 °C. Resulting value of the resistance was recalculated to 75 °C.

Results

Resistances of transformer winding are noted in **Tab. 1.**

Side of transformer	Tap	Terminal	Before type and special tests	
			$R_{measured}$ (Ω)	R_{75} (Ω)
HV	1 (+ 5 %)	1U – 1V	9.636676126	11.61045316
		1U – 1W	9.680634743	11.66341535
		1V – 1W	9.660335285	11.63895817
	3 (0 %)	1U – 1V	9.129011656	10.99880922
		1U – 1W	9.165738826	11.04305883
		1V – 1W	9.155209410	11.03037278
	5 (- 5 %)	1U – 1V	8.623641358	10.38992935
		1U – 1W	8.662324251	10.43653524
		1V – 1W	8.598903282	10.36012444
LV		2n – 2u	0.001932286	0.002326247
		2n – 2v	0.001916093	0.002307650
		2n – 2w	0.001916987	0.002308726

Tab. 1: Resistances of transformer winding.

Measurement of short-circuit impedance and load loss

Description

Measurement of short-circuit impedance and load loss was performed according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Voltage was applied to HV terminals of the transformer, LV terminals were short circuited. Supply current of 50 Hz was ca. 4 A. Temperature was 22.5 °C.

Measured values of short-circuit impedance and load loss were corrected for the reference temperature 75 °C.

Results

Measured values of short-circuit impedance and load loss are noted in **Tab. 2.**

	Z a Δ P_k		
Tapping	1 (+ 5 %)	3 (0 %)	5 (- 5 %)
$Z_{measured}$ (Ω)	44.52	40.24	35.60
Z_{75} (Ω)	44.93	40.71	36.17
Δ $P_{k\ measured}$ (W)	3 217.76	3 871.41	4 650.32
Δ $P_{k\ 75}$ (W)	3 953.37	4 570.21	5 342.73

Tab. 2: Values of the short-circuit impedance and load loss.

Measurement of no-load loss and currents

Description

Measurement of no-load losses and currents was performed according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer in temperature steady state.

Supply voltage was applied to LV terminals of the transformer; HV terminals were no-loaded. Supply voltage during the measurement was set to 90 %, 100 % and 110 % of rated voltage U_2.

Results

Measured values of no-load losses and currents are noted in **tab. 3** and **4.**

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
Δ P_0 (W)	328.0	421.4	546,6

Tab. 3: Values of the no-load losses.

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
I_0 (A)	1.0247	1.1057	1.4079

Tab. 4: Values of the no-load currents.

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according to section 16 of Act No. 22/1997 Coll., on technical requirements for products, as amended

CERTIFICATE OF ACCREDITATION

No. 660 / 2015

ETD TRANSFORMÁTORY a.s.
with registered office Zborovská 54/22, 301 00 Plzeň, Company Registration No. 25137808

to the Testing Laboratory No. 1526
ELECTRICAL TESTING LABORATORY

Scope of accreditation:

Electrical and air-handling testing and measuring of industrial equipment to the extent as specified in the appendix to this Certificate.

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Prague: 21 September 2015

Jiří Růžička
Director
Czech Accreditation Institute
Public Service Company

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ETD TRANSFORMÁTORY a.s.
ELEKTROTECHNICKÁ ZKUŠEBNA
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Total sheets: 5

Test Report

AP_EZ/2016/050/01/EN

Customer:	BEZ TRANSFORMÁTORY a.s. Rybničná 40 835 54 Bratislava
Tested object:	**Transformer TOHn 379/22, s.n. 0363137**
Test take over date:	September 23th , 2016
Test realization date:	September 26th , 2016
Test identification No.:	365-302-1624 **Evidentiary No:** 48/2016
Order No:	B06/4500006720

Testing methods, regulations:

ACCREDITED TESTS ACCORDING TO SOP_EZ/2, 4, 6 and 8:

ČSN EN 60076-1, Clause 11.2	Measurement of winding resistance
ČSN EN 60076-1, Clause 11.4	Measurement of short-circuit impedance and load loss
ČSN EN 60076-1, Clause 11.5	Measurement of no-load loss and current

Test results: In the text.

Enclosures: 1

AKREDITOVANÁ ELEKTROTECHNICKÁ ZKUŠEBNA L. 1526 ETD TRANSFORMÁTORY a.s.

In Plzeň, 30th September 2016

Petr Šíma
Electrical Testing Laboratory Director

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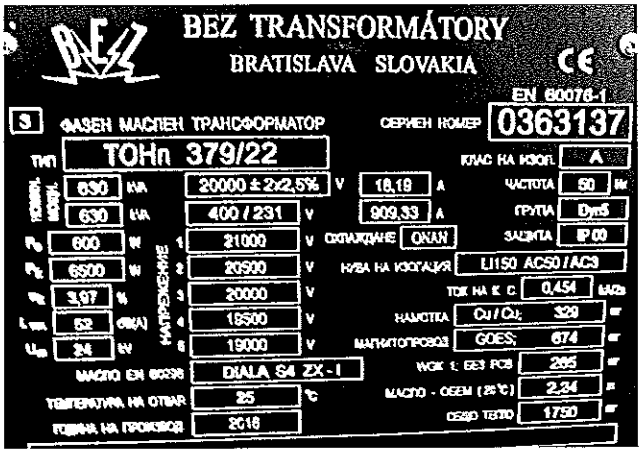
Contents

Tested object

Oil-immersed transformer TOHn 379/22.



Performed tests

Routine tests:

- Measurement of winding resistance according to the Standard ČSN EN 60076-1, Clause 11.2. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of short-circuit impedance and load loss according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of no-load loss and current according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer.

Used apparatuses

Name	Type	Filing No.
Digital multimeter	Fluke 189	PMMm 263
Digital multimeter	Fluke 179	PMMm 269
Isolating converters	BB3652	PMMp 254
Digital thermometer	GMH 3710	PMMt 268
Current transformer	ABB Petercem EA100	PMTr 92
Current transformer	ABB Petercem EA100	PMTr 93
Current transformer	ABB Petercem EA100	PMTr 94

Measurement of winding resistance

Description

The measurement of winding resistance was performed according to the Standard ČSN EN 60076-1, Clause 11.2.3. Measurement was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Winding resistances each of above mentioned tappings were measured with DC current, with Ohm's method, between terminals of each phase on HV side of transformer and between node and terminal of respective phase on LV side of tested transformer. The mean temperature of cooling liquid (temperature of transformer winding) was measured during the test. Temperature was 22.4 °C. Resulting value of the resistance was recalculated to 75 °C.

Results

Resistances of transformer winding are noted in **Tab. 1.**

Side of transformer	Tap	Terminal	Before type and special tests	
			$R_{measured}$ (Ω)	R_{75} (Ω)
HV	1 (+ 5 %)	1U – 1V	5.413261123	6.519467553
		1U – 1W	5.419628383	6.527135970
		1V – 1W	5.430576016	6.540320765
	3 (0 %)	1U – 1V	5.125074746	6.172389943
		1U – 1W	5.133326675	6.182328164
		1V – 1W	5.142458309	6.193325858
	5 (- 5 %)	1U – 1V	4.840437458	5.829586682
		1U – 1W	4.847244409	5.837784642
		1V – 1W	4.857349674	5.849954930
LV		2n – 2u	0.001054948	0.001270528
		2n – 2v	0.001087017	0.001301563
		2n – 2w	0.001103326	0.001328792

Tab. 1: Resistances of transformer winding.

Measurement of short-circuit impedance and load loss

Description

Measurement of short-circuit impedance and load loss was performed according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Voltage was applied to HV terminals of the transformer, LV terminals were short circuited. Supply current of 50 Hz was ca. 10 A. Temperature was 22.7 °C.

Measured values of short-circuit impedance and load loss were corrected for the reference temperature 75 °C.

Results

Measured values of short-circuit impedance and load loss are noted in **Tab. 2.**

	Z a Δ P_k		
Tapping	1 (+ 5 %)	3 (0 %)	5 (- 5 %)
$Z_{measured}$ (Ω)	28.34	25.14	22.31
Z_{75} (Ω)	28.54	25.38	22.60
Δ $P_{k\ measured}$ (W)	4 619.76	5 524.28	6 631.54
Δ $P_{k\ 75}$ (W)	5 637.77	6 495.30	7 594.04

Tab. 2: Values of the short-circuit impedance and load loss.

Measurement of no-load loss and currents

Description

Measurement of no-load losses and currents was performed according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer in temperature steady state.

Supply voltage was applied to LV terminals of the transformer; HV terminals were no-loaded. Supply voltage during the measurement was set to 90 %, 100 % and 110 % of rated voltage U_2.

Results

Measured values of no-load losses and currents are noted in **tab. 3** and **4.**

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
Δ P_0 (W)	448.2	586.2	813.1

Tab. 3: Values of the no-load losses.

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
I_0 (A)	1.0504	1.6423	6.5117

Tab. 4: Values of the no-load currents.

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according to section 16 of Act No 22/1997 Coll., on technical requirements for products, as amended

CERTIFICATE OF ACCREDITATION

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tel.: +420 373 031 660, fax: +420 373 031 662, e-mail: info-ez@etd-bez.cz

L 1526

Total sheets: 5

Test Report

AP_EZ/2016/051/01/EN

Customer:	BEZ TRANSFORMÁTORY a.s. Rybničná 40 835 54 Bratislava		
Tested object:	**Transformer TOHn 389/22, s.n. 0361831**		
Test take over date:	September 23th , 2016		
Test realization date:	September 26th , 2016		
Test identification No.:	365-302-1624	**Evidentiary No:**	48/2016
Order No:	B06/4500006720		

Testing methods, regulations:

ACCREDITED TESTS ACCORDING TO SOP_EZ/2, 4, 6 and 8:

ČSN EN 60076-1, Clause 11.2	Measurement of winding resistance
ČSN EN 60076-1, Clause 11.4	Measurement of short-circuit impedance and load loss
ČSN EN 60076-1, Clause 11.5	Measurement of no-load loss and current

Test results: In the text.

Enclosures: 1

In Plzeň, 30th September 2016

Petr Šíma
Electrical Testing Laboratory Director

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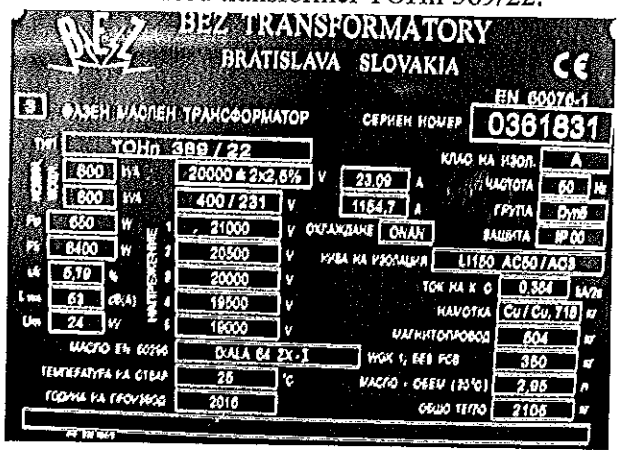
Tested object

Oil-immersed transformer TOHn 389/22.



Performed tests

Routine tests:

- Measurement of winding resistance according to the Standard ČSN EN 60076-1, Clause 11. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of short-circuit impedance and load loss according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of no-load loss and current according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer.

Used apparatuses

Name	Type	Filing No.
Digital multimeter	Fluke 189	PMMm 263
Digital multimeter	Fluke 179	PMMm 269
Isolating converters	BB3652	PMMp 254
Digital thermometer	GMH 3710	PMMt 268
Current transformer	ABB Petercem EA100	PMTr 92
Current transformer	ABB Petercem EA100	PMTr 93
Current transformer	ABB Petercem EA100	PMTr 94

Measurement of winding resistance

Description

The measurement of winding resistance was performed according to the Standard ČSN EN 60076-1, Clause 11.2.3. Measurement was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Winding resistances each of above mentioned tappings were measured with DC current, with Ohm's method, between terminals of each phase on HV side of transformer and between node and terminal of respective phase on LV side of tested transformer. The mean temperature of cooling liquid (temperature of transformer winding) was measured during the test. Temperature was 22.5 °C. Resulting value of the resistance was recalculated to 75 °C.

Results

Resistances of transformer winding are noted in **Tab. 1.**

Side of transformer	Tap	Terminal	Before type and special tests	
			$R_{measured}$ (Ω)	R_{75} (Ω)
HV	1 (+5 %)	1U – 1V	4.130217695	4.972300915
		1U – 1W	4.122274221	4.962737897
		1V – 1W	4.131014447	4.973260110
	3 (0 %)	1U – 1V	3.907538807	4.704221476
		1U – 1W	3.898721044	4.693605917
		1V – 1W	3.905860784	4.702201332
	5 (-5 %)	1U – 1V	3.686047671	4.437571954
		1U – 1W	3.678689180	4.428713187
		1V – 1W	3.686406004	4.438003344
LV		2n – 2u	0.000788773	0.000949591
		2n – 2v	0.000777999	0.000936620
		2n – 2w	0.000799017	0.000961923

Tab. 1: Resistances of transformer winding.

Measurement of short-circuit impedance and load loss

Description

Measurement of short-circuit impedance and load loss was performed according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Voltage was applied to HV terminals of the transformer, LV terminals were short circuited. Supply current of 50 Hz was ca. 13 A. Temperature was 22.7 °C.

Measured values of short-circuit impedance and load loss were corrected for the reference temperature 75 °C.

Results

Measured values of short-circuit impedance and load loss are noted in **Tab. 2.**

	Z a Δ P_k		
Tapping	1 (+ 5 %)	3 (0 %)	5 (- 5 %)
$Z_{measured}$ (Ω)	32.70	28.82	25.49
Z_{75} (Ω)	32.79	28.94	25.62
Δ $P_{k\ measured}$ (W)	5 745.95	6 885.53	8 291.65
Δ $P_{k\ 75}$ (W)	6 900.20	7 998.12	9 372.92

Tab. 2: Values of the short-circuit impedance and load loss.

Measurement of no-load loss and currents

Description

Measurement of no-load losses and currents was performed according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer in temperature steady state.

Supply voltage was applied to LV terminals of the transformer; HV terminals were no-loaded. Supply voltage during the measurement was set to 90 %, 100 % and 110 % of rated voltage U_2.

Results

Measured values of no-load losses and currents are noted in **tab. 3** and **4.**

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
Δ P_0 (W)	478.1	643.8	869.4

Tab. 3: Values of the no-load losses.

	90 % U_2 (208 V)	100 % U_2 (231 V)	110 % U_2 (254 V)
I_0 (A)	1.0976	1.7373	6.5700

Tab. 4: Values of the no-load currents.

NÁRODNÍ AKREDITAČNÍ ORGÁN

EA MLA Signatory
Český institut pro akreditaci, o.p.s.
Olšanská 54/3, 130 00 Praha 3

issues

according to section 16 of Act No. 22/1997 Coll., on technical requirements for products, as amended

CERTIFICATE OF ACCREDITATION

No. 660 / 2015

ETD TRANSFORMÁTORY a.s.
with registered office Zborovská 54/22, 301 00 Plzeň, Company Registration No. 25137808

to the Testing Laboratory No. 1526
ELECTRICAL TESTING LABORATORY

Scope of accreditation:

Electrical and air-handling testing and measuring of industrial equipment to the extent as specified in the appendix to this Certificate.

This Certificate of Accreditation is a proof of Accreditation issued on the basis of assessment of fulfillment of the accreditation criteria in accordance with

ČSN EN ISO/IEC 17025:2005

In its activities performed within the scope and for the period of validity of this Certificate, the Body is entitled to refer to this Certificate, provided that the accreditation is not suspended and the Body meets the specified accreditation requirements in accordance with the relevant regulations applicable to the activity of an accredited Conformity Assessment Body.

This Certificate of Accreditation replaces, to the full extent, Certificate No.: 474/2014 of 15 July 2014, or any administrative acts building upon it.

The Certificate of Accreditation is valid until: **1 July 2018**

Prague: 21 September 2015

Jiří Růžička
Director
Czech Accreditation Institute
Public Service Company

Methods used in testing are specified in the Quality Manual of the Electrical Testing Laboratory and satisfy the precision requirements according to the respective standards. The presented test results are in relation to the subject of these tests only. The Test Report may be reproduced only as a whole.
In case of discrepancies the Czech version of the Test Report takes precedence.

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Skúšobne TSÚ - Skúšobňa technickej akustiky a spotrebného tovaru
Tel.: +421-33-7957173, 199 Fax: +421-33-7957172 E-mail: dusan.letko@tsu.sk www.tsu.sk

SNAS Reg. No. 009/S-047

Test Report
№.: 164000138/4

Name of measurement:	Measurement of airborne noise emission
Name of product:	Transformer
Part Name:	TOHn 338/10
Serial number:	0363131
Specified parameters:	VN: 10000 VAC +/-2x2,5%; NN: 400/231 VAC; 50 Hz; ; 250 kVA;
Manufacturer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Customer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Measurement place:	Semi-anechoic testing room, BEZ Transformátory, a.s., Bratislava
Measurement method:	STN EN ISO 3744; STN EN 60076-10
Order number:	B06/4500005987 / 06.07.2016

Date of issue: 20th July 2016

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Skúšobňa TSÚ
Krajinská cesta 2929/9
92101 PIEŠŤANY
-321-

Tested and elaborated by: Dipl. Ing. Dušan Miklo

Checked and approved by: Dipl. Ing. Dušan Letko
Head of laboratory

Distribution list: 1x – Customer
1x – TSÚ Piešťany, š.p.

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Instrumentation used

Name	Type	Serial number	Manufacturer
Microphone	B&K 4189	2741387	Brüel& Kjær, Denmark
Frequency analyser	B&K 2250	2739661	Brüel& Kjær, Denmark
Acoustic calibrator	B&K 4231	2725611	Brüel& Kjær, Denmark
Reference sound source	B&K 4204	680788	Brüel& Kjær, Denmark
Digital logger	ALMEMO 2290-4	H01060898M	AHLBORN, Germany
Thermometer and humidity probe	FH-A646-11	01080716	AHLBORN, Germany
Barometer	FDA612-MA	01080293	AHLBORN, Germany

Instrumentation are metrologically traceable to the standards of accredited calibration laboratory of the Technical Acoustics and Consumer Goods Testing Body in TSU Piestany, s. p. as specified in time intervals in according to quality manual of Testing body.

Measurement method

STN EN ISO 3744 (01 1604) Acoustics. Determination of sound power levels of noise sources using sound pressure. Engineering method in an essentially free field over a reflecting plane.

STN EN 60076 (01 1604) Power transformers. Part 10: Determination of sound levels.

Measurement conditions

– *Date of measurement:* 6th July 2016

– *Atmospheric*: t_0 = 22,9°C; RH = 59,6 %; p_0= 100,1kPa

– *Acoustic:* Free field over a reflecting plane in the semi-anechoic testing room. Averaged background noise level L_{pA}< 18,0 dB.

– *Operation*: Transformer under test was placed on a reflecting plane of the testing space when measured. The transformer was in operating mode without load during the measurement. Supply voltage:3 x 420 VAC / 50 Hz.

– *Measuring:* The microphone positions were evenly situated on measuring line around transformer in height v = 0,435 m over the reflecting plane. Number of the measurement points: 16. Height of transformer container: h = 0,87 m. Measuring distance d = 0,3 m. Measurement surface S = 6,26 m^2.

The sound power level L_W and the sound power levels in one-third octave frequency bands $L_{W1/3\ oct}$, shall be calculated as follows

$$L_W = L_{pf} + 10 \cdot \log\left(\frac{S}{S_0}\right) \quad [dB] \quad (re.\ 10^{-12}\ W)$$

where L_{pf} is the surface sound pressure level corrected for background noise and acoustical environment, in decibels (re. 20 µPa);
S is the area of the measurement surface, in square meters; S_0 = 1 m^2 ;

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Operation status: NO LOAD — **Table 1**

Frequency[Hz]	50	63	80	100	125	160	200	250	315	400	500	630
$L_{W1/3oct}$ [dB] (ref. 1 pW)	28,6	22,3	18,1	37,8	20,2	21,8	39,4	29,7	41,4	32,3	31,8	36,3
Frequency[Hz]	800	1 k	1,25k	1,6k	2k	2,5k	3,15k	4k	5k	6,3k	8k	10k
$L_{W1/3oct}$ [dB] (ref. 1 pW)	33,7	25,6	19,5	19,7	28,5	28,9	25,2	23,0	28,6	28,0	36,0	39,4

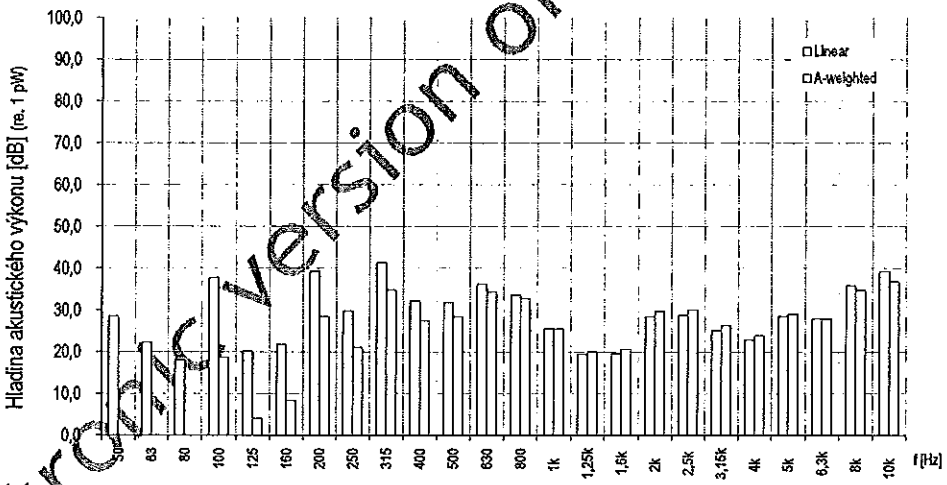
Sound pressure level L_{pf} = **39,6** (ref. 20 µPa)

A-weighted sound pressure level L_{pAf} = **35,5 dB** (ref. 20 µPa)

Environmental correction K_{2A} = **0,3 dB**

Sound power level L_W = **47,6 dB** (ref. 1pW)

A-weighted sound power level L_{WA} = **43,5 dB** (ref. 1pW)



$L_{W1/3oct}$ is the sound power level in one-third octave frequency bands, in decibels;
L_W is the sound power level, in decibels;
L_{WA} is the A-weighted sound power level, in decibels.
background noise too high in this frequency band

The expanded measurement uncertainty of A-weighted sound power level L_{WA}, for a coverage probability of 95% (coverage factor k = 2) as defined in the TPM 0051–93, is 1,2 dB.

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Test Report
№.: 164000138/1

Name of measurement:	Measurement of airborne noise emission
Name of product:	Transformer
Part Name:	TOHn 358/10
Serial number:	0363335
Specified parameters:	VN: 10000 VAC +/-2x2,5%; NN: 400/231 VAC; 50 Hz; ; 400 kVA;
Manufacturer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Customer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Measurement place:	Semi-anechoic testing room, BEZ Transformátory, a.s., Bratislava
Measurement method:	STN EN ISO 3744; STN EN 60076-10
Order number:	B06/4500005987 / 06.07.2016

Date of issue: 20th July 2016

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Tested and elaborated by: Dipl. Ing. Dušan Miklo

Checked and approved by: Dipl. Ing. Dušan Letko
Head of laboratory

Distribution list: 1x – Customer
1x – TSÚ Piešťany, š.p.

Instrumentation used

Name	Type	Serial number	Manufacturer
Microphone	B&K 4189	2741387	Brüel& Kjær, Denmark
Frequency analyser	B&K 2250	2739661	Brüel& Kjær, Denmark
Acoustic calibrator	B&K 4231	2725611	Brüel& Kjær, Denmark
Reference sound source	B&K 4204	680788	Brüel& Kjær, Denmark
Digital logger	ALMEMO 2290-4	H01060898M	AHLBORN, Germany
Thermometer and humidity probe	FH-A646-11	01080716	AHLBORN, Germany
Barometer	FDA612-MA	01080293	AHLBORN, Germany

Instrumentation are metrologically traceable to the standards of accredited calibration laboratory of the Technical Acoustics and Consumer Goods Testing Body in TSU Piestany, s.p. as specified in time intervals in according to quality manual of Testing body.

Measurement method

STN EN ISO 3744 (01 1604) Acoustics. Determination of sound power levels of noise sources using sound pressure. Engineering method in an essentially free field over a reflecting plane.

STN EN 60076 (01 1604) Power transformers. Part 10: Determination of sound levels.

Measurement conditions

– *Date of measurement:* 6th July 2016

– *Atmospheric:* t_0 = 22,9°C; RH = 59,6 %; p_0= 100,1kPa

– *Acoustic:* Free field over a reflecting plane in the semi-anechoic testing room. Averaged background noise level L_{pA}< 18,0 dB.

– *Operation:* Transformer under test was placed on a reflecting plane of the testing space when measured. The transformer was in operating mode without load during the measurement. Supply voltage:3 x 420 VAC / 50 Hz.

– *Measuring:* The microphone positions were evenly situated on measuring line around transformer in height v = 0,475 m over the reflecting plane. Number of the measurement points: 16. Height of transformer container: h = 0,95 m. Measuring distance d = 0,3 m. Measurement surface S = 7,41 m^2.

The sound power level L_W and the sound power levels in one-third octave frequency bands $L_{W1/3\ oct}$, shall be calculated as follows

$$L_W = L_{pf} + 10 \cdot \log\left(\frac{S}{S_0}\right) \quad [dB] \quad (re.\ 10^{-12}\ W)$$

where L_{pf} is the surface sound pressure level corrected for background noise and acoustical environment, in decibels (re. 20 µPa);
S is the area of the measurement surface, in square meters; S_0 = 1 m^2 ;

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Operation status: NO LOAD — **Table 1**

Frequency[Hz]	50	63	80	100	125	160	200	250	315	400	500	630
$L_{W1/3oct}$ [dB] (ref. 1 pW)	26,2	26,4	20,0	42,6	24,9	19,4	38,3	31,2	44,8	36,4	36,3	40,7
Frequency[Hz]	800	1 k	1,25k	1,6k	2k	2,5k	3,15k	4k	5k	6,3k	8k	10k
$L_{W1/3oct}$ [dB] (ref. 1 pW)	38,5	23,4	14,1	19,6	27,6	28,5	25,1	25,3	28,9	29,6	36,1	33,4

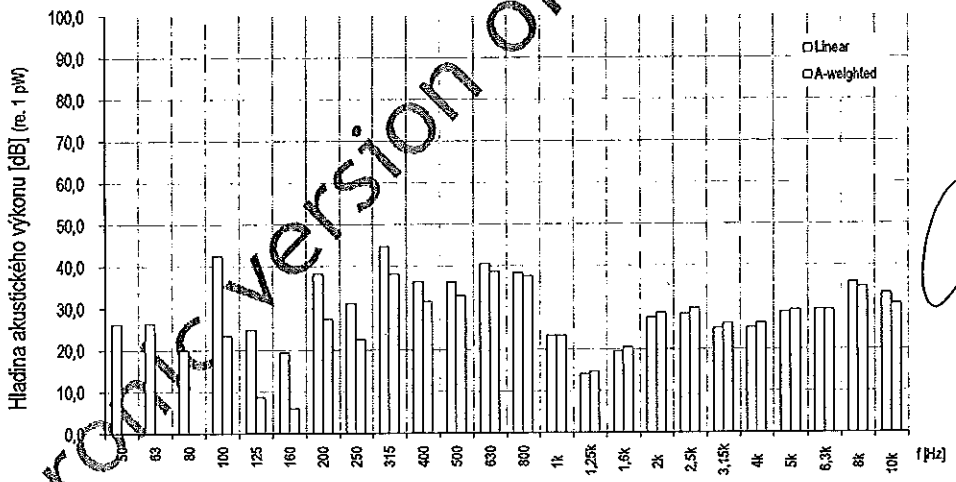
Sound pressure level L_{pf} = **41,1** (ref. 20 µPa)

A-weighted sound pressure level L_{pAf} = **36,6 dB** (ref. 20 µPa)

Environmental correction K_{2A} = **0,3 dB**

Sound power level L_W = **49,8 dB** (ref. 1pW)

A-weighted sound power level L_{WA} = **45,3 dB** (ref. 1pW)



$L_{W1/3oct}$ is the sound power level in one-third octave frequency bands, in decibels;
L_W is the sound power level, in decibels;
L_{WA} is the A-weighted sound power level, in decibels.
background noise too high in this frequency band

The expanded measurement uncertainty of A-weighted sound power level L_{WA}, for a coverage probability of 95% (coverage factor k = 2) as defined in the TPM 0051–93, is 1,2 dB.

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Test Report №.: 164000207/3

Name of measurement:	Measurement of airborne noise emission
Name of product:	Transformer
Part Name:	TOHn 378/10
Serial number:	0361503
Specified parameters:	VN: 10000 VAC +/-2x2,5%; NN: 400/231 VAC; 50 Hz; ; 630 kVA;
Manufacturer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Customer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Measurement place:	Semi-anechoic testing room, BEZ Transformátory, a.s., Bratislava
Measurement method:	STN EN ISO 3744; STN EN 60076-10
Order number:	B06/4500006783 / 03.10.2016

Date of issue: 10h October 2016

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Skúšobňa TSÚ
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Tested and elaborated by:
Dipl. Ing. Dušan Miklo
Test Engineer

Checked and approved by:
Dipl. Ing. Tomáš Bednárik
Technical Head

Distribution list: 1x – Customer
1x – TSÚ Piešťany, š.p.

Instrumentation used

Name	Type	Serial number	Manufacturer
Microphone	B&K 4189	2741387	Brüel& Kjær, Denmark
Frequency analyser	B&K 2250	2739661	Brüel& Kjær, Denmark
Acoustic calibrator	B&K 4231	2725611	Brüel& Kjær, Denmark
Reference sound source	B&K 4204	680788	Brüel& Kjær, Denmark
Digital logger	ALMEMO 2290-4	H01060898M	AHLBORN, Germany
Thermometer and humidity probe	FH-A646-11	01080716	AHLBORN, Germany
Barometer	FDA612-MA	01080293	AHLBORN, Germany

Instrumentation are metrologically traceable to the standards of accredited metrological laboratory in TSU Piestany, s. p. as specified in time intervals in according to quality manual of Testing body.

Measurement method

STN EN ISO 3744 (01 1604) Acoustics. Determination of sound power levels of noise sources using sound pressure. Engineering method in an essentially free field over a reflecting plane.

STN EN 60076 (01 1604) Power transformers. Part 10: Determination of sound levels.

Measurement conditions

– *Date of measurement:* 29. 09. 2016

– *Atmospheric*: t_0 = (20,1 – 21,1) °C; RH = (49,2 – 49,7) %; p_0= (100,1 – 100,3) kPa

– *Acoustic:* Free field over a reflecting plane in the semi-anechoic testing room. Averaged background noise level L_{pA}< 17,0 dB.

– *Operation*: Transformer under test was placed on a reflecting plane of the testing space when measured. The transformer was in operating mode without load during the measurement. Supply voltage:3 x 400 VAC / 50 Hz.

– *Measuring:* The microphone positions were evenly situated on measuring line around transformer in height v = 0,50 m over the reflecting plane. Number of the measurement points: 16. Height of transformer container: h = 1,00 m. Measuring distance d = 0,3 m. Measurement surface S = 8,20 m^2.

The sound power level L_W and the sound power levels in one-third octave frequency bands $L_{W1/3\,oct}$, shall be calculated as follows

$$L_W = L_{pf} + 10 \cdot \log\left(\frac{S}{S_0}\right) \quad [dB] \quad (re.\ 10^{-12}\ W)$$

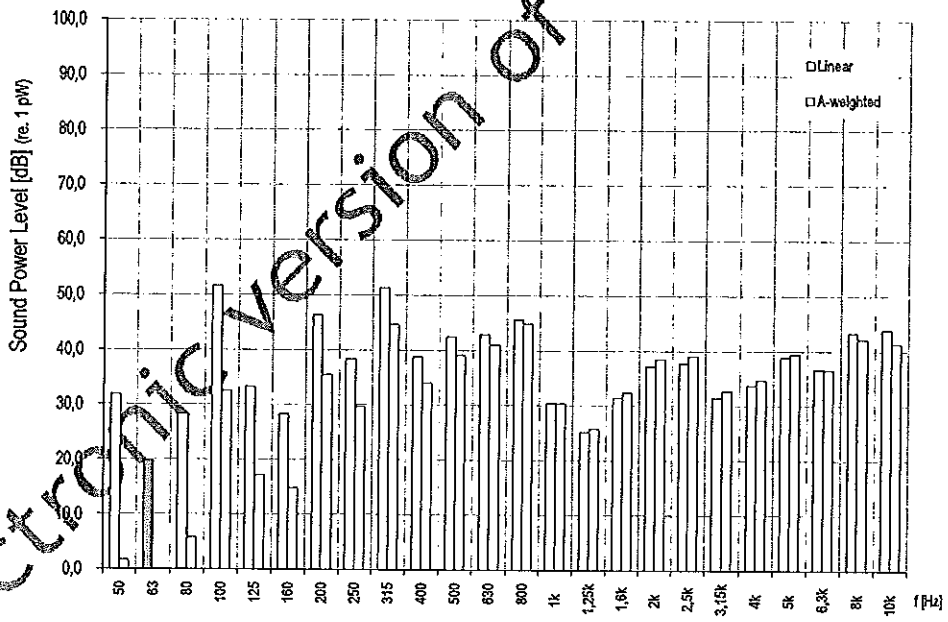
where L_{pf} is the surface sound pressure level corrected for background noise and acoustical environment, in decibels (re. 20 µPa);

S is the area of the measurement surface, in square meters; S_0 = 1 m^2 ;

Operation status: NO LOAD	**Table 1**

Frequency [Hz]	50	63	80	100	125	160	200	250	315	400	500	630
$L_{W1/3oct}$ [dB] (ref. 1 pW)	31,9	19,9	28,4	51,6	33,3	28,3	46,4	38,3	51,3	38,8	42,5	42,9
Frequency [Hz]	800	1 k	1,25k	1,6k	2k	2,5k	3,15k	4k	5k	6,3k	8k	10k
$L_{W1/3oct}$ [dB] (ref. 1 pW)	45,6	30,4	25,2	31,5	37,3	37,7	31,5	33,7	38,9	36,7	43,3	43,9

Sound pressure level L_{pf} = **47,8 dB** (ref. 20 µPa)
A-weighted sound pressure level L_{pAf} = **42,8 dB** (ref. 20 µPa)
Environmental correction K_{2A} = **0,3 dB**
Sound power level L_W = **56,9 dB** (ref. 1pW)
A-weighted sound power level L_{WA} = **52,0 dB** (ref. 1pW)



$L_{W1/3\ oct}$	is the sound power level in one-third octave frequency bands, in decibels;
L_W	is the sound power level, in decibels;
L_{WA}	is the A-weighted sound power level, in decibels.
•	background noise too high in this frequency band

The expanded measurement uncertainty of A-weighted sound power level L_{WA}, for a coverage probability of 95% (coverage factor k = 2) as defined in the TPM 0051–93, is 1,2 dB.

the end of a test report

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Test Report №.: 164000207/1

Name of measurement:	Measurement of airborne noise emission
Name of product:	Transformer
Part Name:	TOHn 388/10
Serial number:	0361830
Specified parameters:	VN: 10000 VAC +/-2x2,5%; NN: 400/231 VAC; 50 Hz; ; 800 kVA;
Manufacturer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Customer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Measurement place:	Semi-anechoic testing room, BEZ Transformátory, a.s., Bratislava
Measurement method:	STN EN ISO 3744; STN EN 60076-10
Order number:	B06/4500006783 / 03.10.2016

Date of issue: 10th October 2016

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Tested and elaborated by:
Dipl. Ing. Dušan Miklo
Test Engineer

Checked and approved by:
Dipl. Ing. Tomáš Bednárik
Technical Head

Distribution list: 1x – Customer
1x – TSÚ Piešťany, š.p.

Instrumentation used

Name	*Type*	*Serial number*	*Manufacturer*
Microphone	B&K 4189	2741387	Brüel& Kjær, Denmark
Frequency analyser	B&K 2250	2739661	Brüel& Kjær, Denmark
Acoustic calibrator	B&K 4231	2725611	Brüel& Kjær, Denmark
Reference sound source	B&K 4204	680788	Brüel& Kjær, Denmark
Digital logger	ALMEMO 2290-4	H01060898M	AHLBORN, Germany
Thermometer and humidity probe	FH-A646-11	01080716	AHLBORN, Germany
Barometer	FDA612-MA	01080293	AHLBORN, Germany

Instrumentation are metrologically traceable to the standards of accredited metrological laboratory in TSU Piestany, s. p. as specified in time intervals in according to quality manual of Testing body.

Measurement method

STN EN ISO 3744 (01 1604) Acoustics. Determination of sound power levels of noise sources using sound pressure. Engineering method in an essentially free field over a reflecting plane.

STN EN 60076 (01 1604) Power transformers. Part 10: Determination of sound levels.

Measurement conditions

– *Date of measurement:* 29. 09. 2016

– *Atmospheric*: t_0 = (20,1 – 21,1) °C; RH = (49,2 – 49,7) %; p_0= (100,1 – 100,3) kPa

– *Acoustic:* Free field over a reflecting plane in the semi-anechoic testing room. Averaged background noise level L_{pA}< 17,0 dB.

– *Operation*: Transformer under test was placed on a reflecting plane of the testing space when measured. The transformer was in operating mode without load during the measurement. Supply voltage:3 x 400 VAC / 50 Hz.

– *Measuring:* The microphone positions were evenly situated on measuring line around transformer in height v = 0,51 m over the reflecting plane. Number of the measurement points: 16. Height of transformer container: h = 1,02 m; Measuring distance d = 0,3 m. Measurement surface S = 9,18 m^2.

The sound power level L_W and the sound power levels in one-third octave frequency bands $L_{W1/3\,oct}$, shall be calculated as follows

$$L_W = L_{pf} + 10 \cdot \log\left(\frac{S}{S_0}\right) \quad [dB] \quad (re.\ 10^{-12}\ W)$$

where L_{pf} is the surface sound pressure level corrected for background noise and acoustical environment, in decibels (re. 20 μPa);
S is the area of the measurement surface, in square meters; S_0 = 1 m^2 ;

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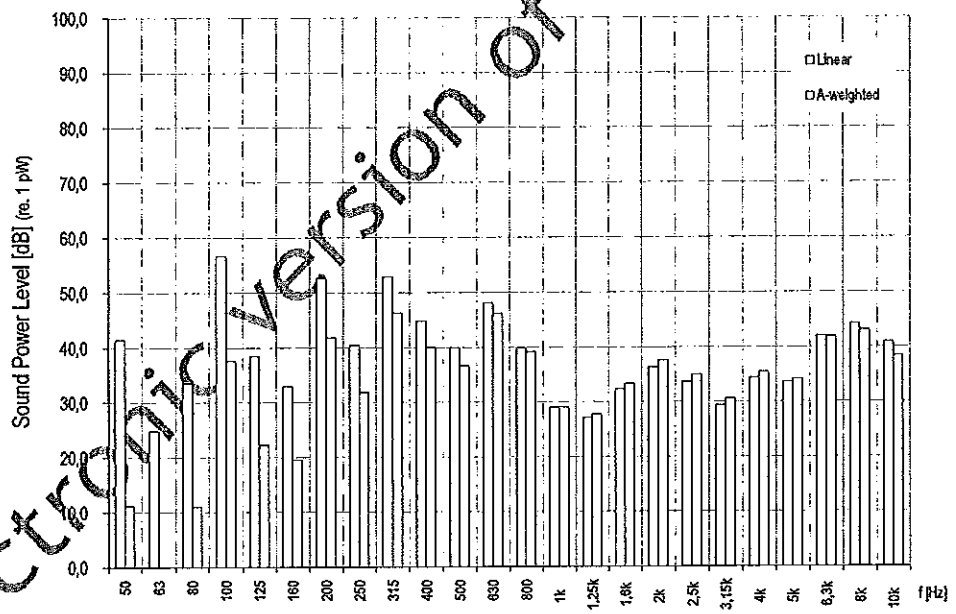
Operation status: NO LOAD	**Table 1**

Frequency [Hz]	50	63	80	100	125	160	200	250	315	400	500	630
$L_{W1/3oct}$ [dB] (ref. 1 pW)	41,5	24,9	33,6	56,7	38,5	33,0	52,8	40,5	52,9	44,9	40,0	48,1
Frequency [Hz]	800	1 k	1,25k	1,6k	2k	2,5k	3,15k	4k	5k	6,3k	8k	10k
$L_{W1/3oct}$ [dB] (ref. 1 pW)	39,9	29,2	27,2	32,4	36,4	33,7	29,4	34,5	33,6	42,0	44,3	40,9

Sound pressure level L_{pf} = **50,7 dB** (ref. 20 µPa)
A-weighted sound pressure level L_{pAf} = **43,2 dB** (ref. 20 µPa)
Environmental correction K_{2A} = **0,3 dB**
Sound power level L_W = **60,3 dB** (ref. 1pW)
A-weighted sound power level L_{WA} = **52,9 dB** (ref. 1pW)



$L_{W1/3\ oct}$	is the sound power level in one-third octave frequency bands, in decibels;
L_W	is the sound power level, in decibels;
L_{WA}	is the A-weighted sound power level, in decibels.
•	background noise too high in this frequency band

The expanded measurement uncertainty of A-weighted sound power level L_{WA}, for a coverage probability of 95% (coverage factor k = 2) as defined in the TPM 0051–93, is 1,2 dB.

the end of a test report

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	BEZ TRANSFORMÁTORY, a.s.	Report No.316-103
	Testing Department	

TRANSFORMER NOISE MEASUREMENT REPORT

TYPE OF TRANSFORMER: **TOHn 269/22**
Three-phase

Serial No.: **0362 480**

Working No: 0630.01.01

Rated power: **50kVA**

Connection group: Yzn5
Nominal higher voltage: 20 000±2x2,5%V

Nominal lower voltage: 400/231V

Current higher voltage: 1,44A
Current lower voltage: 72,17A

Impedance voltage: 4,06%at 75°C

OIL:
LYRA X

type natural cooling ONAN
Loading: —
Class insulation: A
Rated frequency: **50Hz**

	no load:	load:
Losses	**85,4W**	1028,1W at 75°C

Total weight **505kg**

CONTRACT – Customer: ČEZ

Manufacturer **BEZ TRANSFORMÁTORY,a.s.**
Rybničná 40
835 54 BRATISLAVA
Slovak Republic

Year of production: **2016**

Measurement method

Determination of sound power levels of noise sources using sound pressure. Engineering method in essentially **free field** over a reflecting plane.

Measurement standard: This transformer comply with the following standard.

STN EN 60076-10

Measurement location: Anechoic room BEZ, a.s., / Volume of the room - 245 m^3.
Sound field in the measurement area complied with the requirements of standard.

Date of measurement: **09. 03. 2016**

Conditions in the measurement location:

Temperature: ±0,5°C	Pressure: ±0,1kPa	Humidity: ±1%
18,2	100,2	61,1

Measuring instruments

BRUEL & KJAER
Real-time, two-channel frequency analyzer, Type 2260 INVESTIGATOR, with basic sound analysis software BZ 7205.
Ser.No. 200 1589

Microphone/Preamplifier

TYPE	TYPE	TYPE	TYPE
RFT MK 102	MV 101	B&K 4190	RFT MV 201
Ser. No.	Ser. No.	Ser. No.	Ser. No.
6125	6446	2639 799	4903

Microphone/Preamplifier

TYPE	TYPE	TYPE	TYPE
RFT MK 102	MV 102	RFT MK 102	MV 102
Ser. No.	Ser. No.	Ser. No.	Ser. No.
10 621	16 149	10 765	14 881

Microphone/Preamplifier

TYPE	TYPE	TYPE	TYPE
RFT MK 102	MV 102	RFT MK 102	MV 102
Ser. No.	Ser. No.	Ser. No.	Ser. No.
26 167	16 060	25 092	15 627

Calibration ----------

Immediately before and after the measurement sequence with a Sound Level Calibrator,
BRUEL&KJAER–Type 4231
Ser. No. 206 1705

calibration frequency	calibration pressure	calibration accuracy
999,78 Hz	94,00dB	± 0,18dB

Calibrator is verified with the requirements of STN EN 60942, (IEC 942).
Instrumentation system is verified with the requirements of ÚNMS SR č.48/2001Z.z.
The date of the last verification: 20. 01. 2016

Sound pressure measurements are performed using the Class1 instrumentation system.

The date of the last verification: 21. 01. 2016.

Calibration and verification was carried out laboratory: TSÚ Piešťany, SNAS Reg. No. 009/K-021.

Test conditions:
Height of test object: 0,820m
Area of the measurement surface: 4,658m^2

Heights of microphones above reflecting plane:

Path 1	Path 2	Path 3
0,410m	—m	—m

Measurement distance **d=0,3m**

NOTICE: Transformer was during measuring in **off load** condition connected on rated voltage of the nominal frequence. Acoustic parameters are evaluated from **12** measuring points distanced **0,3m** from radiated surface.

RESULTS OF MEASURING

The test was carried out in accordance with the specification **STN EN 60076-10**

A–weighted sound pressure levels of the background sound.

Microphone position	Measured Level dB(A)
1	17,6
2	17,2
3	17,2
4	17,2
5	17,3
6	17,3
11	17,2
12	17,1
9	17,5
10	18,1
7	18,6
8	18,6

Energy average / A-weighted sound pressure level (Reference 20.10^{-6} Pa):
17,6 dB(A)

Table with test results

Microphone position	Measured Level dB(A)	Corrected by respect background and enviromental dB(A)
1	27,4	26,61
2	26,9	26,10
3	25,3	24,24
4	28,4	27,76
5	26,2	25,28
6	26,9	26,08
11	27,3	26,55
12	26,9	26,11
9	24,1	22,67
10	27,0	26,08
7	25,2	23,77
8	25,1	23,64

	BEZ TRANSFORMÁTORY, a.s.	Report No.316-103
	Testing Department	

Guaranteed sound power level:
39 dB(A)

Energy average / A-weighted sound pressure level (Reference 20.10^{-6} Pa):

L_{pA} **25,7 dB(A)**

Calculated / A-weighted sound power level (Reference 1.10^{-12} W):

L_{WA} **32,4 dB(A)**

$10x\log(S/S_0)$ 6,683

DATE: 11. 03. 2016

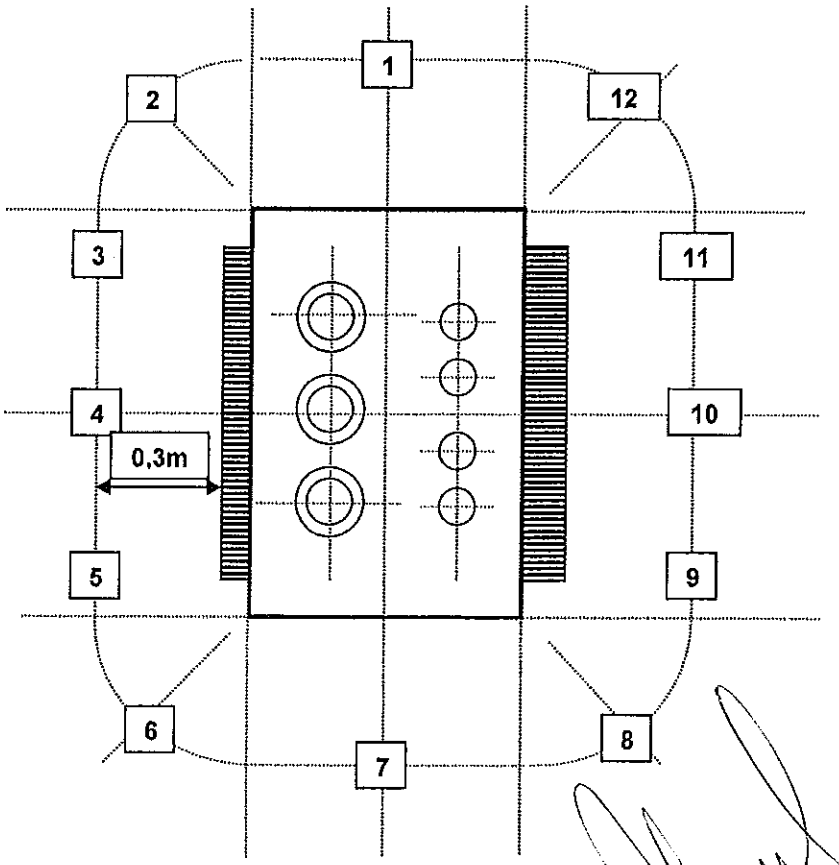
TESTED BY: Ing. Miroslav Šeďo, OSK3
Ing. Martin Gubov, OSK3

CONTROL: Ing.Tomáš Kovarčík, Head of the laboratory OSK3

BEZ TRANSFORMÁTORY, a.s.
Oddelenie typových a zvláštnych skúšok
Rybničná 40
835 54 BRATISLAVA

APPENDIX No. 1 In conformity with REPORT No.: **316 103**

Plan position - measuring points



	BEZ TRANSFORMÁTORY, a.s.	Report No.316-102
	Testing Department	

TRANSFORMER NOISE MEASUREMENT REPORT

TYPE OF TRANSFORMER: **TOHn 299/22**
Three-phase

Serial No.: **0362 640**

Working No: 0633.02.01

Rated power: **100kVA**

Connection group: Yzn5
Nominal higher voltage: 20 000±2x2,5%V

Nominal lower voltage: 400/231V

Current higher voltage: 2,89A
Current lower voltage: 144,34A

Impedance voltage: 3,95%at 75°C

OIL:
LYRA X

type natural cooling ONAN
Loading: —
Class insulation: A
Rated frequency: **50Hz**

	no load:	load:
Losses	**143,6W**	1597,9W at 75°C

Total weight **760kg**

CONTRACT – Customer: ČEZ

Manufacturer **BEZ TRANSFORMÁTORY,a.s.**
Rybničná 40
835 54 BRATISLAVA
Slovak Republic

Year of production: **2016**

Measurement method

Determination of sound power levels of noise sources using sound pressure. Engineering method in essentially **free field** over a reflecting plane.

Measurement standard: This transformer comply with the following standard.

STN EN 60076-10

Measurement location: Anechoic room BEZ, a.s., / Volume of the room - 245 m^3.
Sound field in the measurement area complied with the requirements of standard.

Date of measurement: **29. 03. 2016**

Conditions in the measurement location:

Temperature: ±0,5°C	Pressure: ±0,1kPa	Humidity: ±1%
17,5	99,5	59,0

Measuring instruments

BRUEL & KJAER
Real-time, two-channel frequency analyzer, Type 2260 INVESTIGATOR, with basic sound analysis software BZ 7205.
Ser.No. 200 1589

Microphone/Preamplifier

TYPE	TYPE	TYPE	TYPE
RFT MK 102	MV 101	B&K 4190	RFT MV 201
Ser. No.	Ser. No.	Ser. No.	Ser. No.
6125	6446	2639799	4903

Microphone/Preamplifier

TYPE	TYPE	TYPE	TYPE
RFT MK 102	MV 102	RFT MK 102	MV 102
Ser. No.	Ser. No.	Ser. No.	Ser. No.
10 621	16 149	10 765	14 881

Microphone/Preamplifier

TYPE	TYPE	TYPE	TYPE
RFT MK 102	MV 102	RFT MK 102	MV 102
Ser. No.	Ser. No.	Ser. No.	Ser. No.
26 167	16 060	25 092	15 627

Calibration ----------

Immediately before and after the measurement sequence with a Sound Level Calibrator,
BRUEL&KJAER–Type 4231
Ser. No. 206 1705

calibration frequency	calibration pressure	calibration accuracy
999,78 Hz	94,00dB	± 0,18dB

Calibrator is verified with the requirements of STN EN 60942, (IEC 942).
Instrumentation system is verified with the requirements of ÚNMS SR č.48/2001Z.z.
The date of the last verification: 20. 01. 2016

Sound pressure measurements are performed using the Class1 instrumentation system.

The date of the last verification: 21. 01. 2016.

Calibration and verification was carried out laboratory: TSÚ Piešťany, SNAS Reg. No. 009/K-021.

Test conditions:

Height of test object: 0,785m
Area of the measurement surface: 4,813m^2

Heights of microphones above reflecting plane:

Path 1	Path 2	Path 3
0,395m	–m	–m

Measurement distance **d=0,3m**

NOTICE: Transformer was during measuring in **off load** condition connected on rated voltage of the nominal frequence. Acoustic parameters are evaluated from **12** measuring points distanced **0,3m** from radiated surface.

RESULTS OF MEASURING

The test was carried out in accordance with the specification **STN EN 60076-10**

A–weighted sound pressure levels of the background sound.

Microphone position	Measured Level dB(A)
1	20,89
2	21,48
3	19,99
4	20,06
5	20,63
6	20,33
11	21,65
12	24,43
9	19,7
10	19,99
7	19,87
8	19,87

Table with test results

Microphone position	Measured Level dB(A)	Corrected by respect background and enviromental dB(A)
1	27,68	26,31
2	26,63	24,68
3	24,98	22,96
4	26,22	24,65
5	25,85	23,93
6	27,94	26,77
11	27,4	25,69
12	27,35	23,96
9	27,03	25,80
10	28,36	27,35
7	29,58	28,78
8	29,72	28,94

Energy average / A-weighted sound pressure level (Reference 20.10^{-6} Pa):
21,0 dB(A)

	BEZ TRANSFORMÁTORY, a.s.	Report No.316-102
	Testing Department	

Guaranteed sound power level:
41 dB(A)

Energy average / A-weighted sound pressure level (Reference 20.10^{-6} Pa):

L_{pA} **26,2 dB(A)**

Calculated / A-weighted sound power level (Reference 1.10^{-12} W):

L_{WA} **33,1 dB(A)**

$10x\log(S/S_0)$ 6,825

DATE: 01. 04. 2016

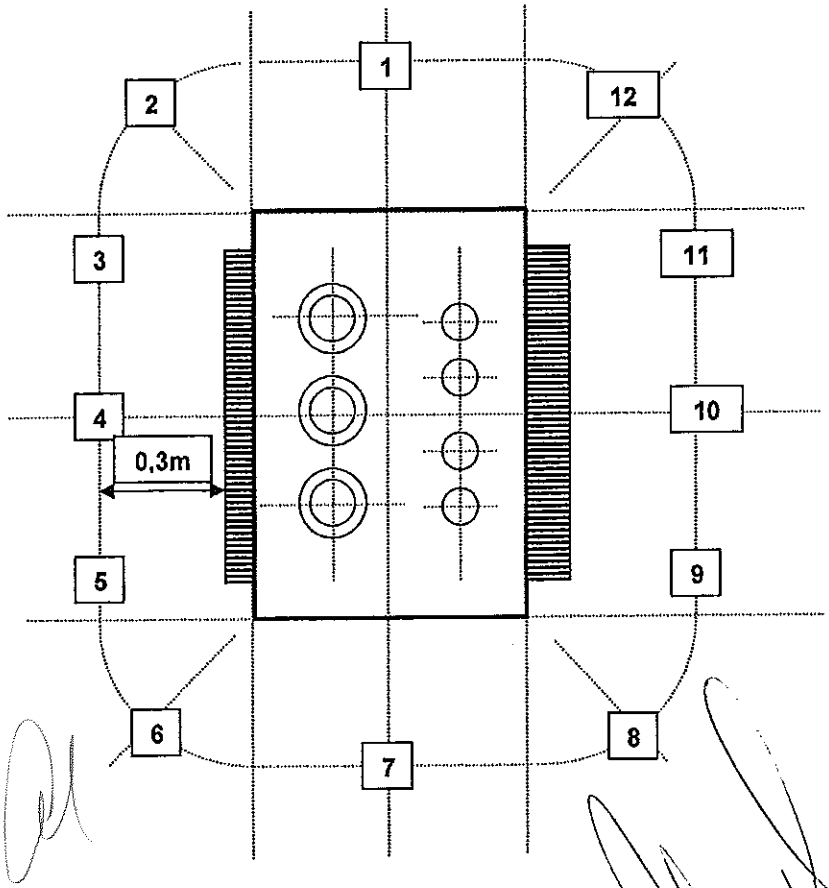
TESTED BY: Ing. Miroslav Šedo, OSK3
Ing. Martin Gubov OSK3

CONTROL: Ing.Tomáš Kovaříčík, Head of the laboratory OSK3

BEZ TRANSFORMÁTORY, a.s.
Oddelenie typových a zvláštnych skúšok
Rybničná 40
835 54 BRATISLAVA

APPENDIX No. 1 In conformity with REPORT No.: **316 102**

Plan position - measuring points



TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.
Krajinská cesta 2929/9, 921 01 Piešťany, Slovenská republika

ilac-MRA SNAS Reg. No. 009/S-047

Skúšobňa TSÚ - Skúšobňa strojov a výrobných zariadení
Tel.: +421-33-7957173, 199 Fax: +421-33-7957172 E-mail: dusan.miklo@tsu.sk www.tsu.sk

Test Report №.: 164000207/5

Name of measurement:	Measurement of airborne noise emission
Name of product:	Transformer
Part Name:	TOHn 319/22
Serial number:	0361960
Specified parameters:	VN: 20000 VAC +/-2x2,5%; NN: 400/231 VAC; 50 Hz; ; 160 kVA;
Manufacturer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Customer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Measurement place:	Semi-anechoic testing room, BEZ Transformátory, a.s., Bratislava
Measurement method:	STN EN ISO 3744; STN EN 60076-10
Order number:	B06/4500006783 / 03.10.2016

Date of issue: 10th October 2016

TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.
Skúšobňa TSÚ
Krajinská cesta 2929/9
92101 PIEŠŤANY
-316-

Tested and elaborated by:
Dipl. Ing. Dušan Miklo
Test Engineer

Checked and approved by:
Dipl. Ing. Tomáš Bednárik
Technical Head

Distribution list: 1x – Customer
1x – TSÚ Piešťany, š.p.

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Instrumentation used

Name	*Type*	*Serial number*	*Manufacturer*
Microphone	B&K 4189	2741387	Brüel& Kjær, Denmark
Frequency analyser	B&K 2250	2739661	Brüel& Kjær, Denmark
Acoustic calibrator	B&K 4231	2725611	Brüel& Kjær, Denmark
Reference sound source	B&K 4204	680788	Brüel& Kjær, Denmark
Digital logger	ALMEMO 2290-4	H01060898M	AHLBORN, Germany
Thermometer and humidity probe	FH-A646-11	01080716	AHLBORN, Germany
Barometer	FDA612-MA	01080293	AHLBORN, Germany

Instrumentation are metrologically traceable to the standards of accredited metrological laboratory in TSU Piestany, s. p. as specified in time intervals in according to quality manual of Testing body.

Measurement method

STN EN ISO 3744 (01 1604) Acoustics. Determination of sound power levels of noise sources using sound pressure. Engineering method in an essentially free field over a reflecting plane.

STN EN 60076 (01 1604) Power transformers. Part 10: Determination of sound levels.

Measurement conditions

– *Date of measurement:* 29. 09. 2016

– *Atmospheric*: t_0 = (20,1 – 21,1) °C; RH = (49,2 – 49,7) %; p_0= (100,1 – 100,3) kPa

– *Acoustic:* Free field over a reflecting plane in the semi-anechoic testing room. Averaged background noise level L_{pA}< 17,0 dB.

– *Operation*: Transformer under test was placed on a reflecting plane of the testing space when measured. The transformer was in operating mode without load during the measurement. Supply voltage:3 x 400 VAC / 50 Hz.

– *Measuring:* The microphone positions were evenly situated on measuring line around transformer in height v = 0,41 m over the reflecting plane. Number of the measurement points: 16. Height of transformer container: h = 0,82 m. Measuring distance d = 0,3 m. Measurement surface S = 5,70 m^2.

The sound power level L_W and the sound power levels in one-third octave frequency bands $L_{W1/3\,oct}$, shall be calculated as follows

$$L_W = L_{pf} + 10 \cdot \log\left(\frac{S}{S_0}\right) \quad [dB] \quad (re.\ 10^{-12}\ W)$$

where L_{pf} is the surface sound pressure level corrected for background noise and acoustical environment, in decibels (re. 20 µPa);
S is the area of the measurement surface, in square meters; S_0 = 1 m^2 ;

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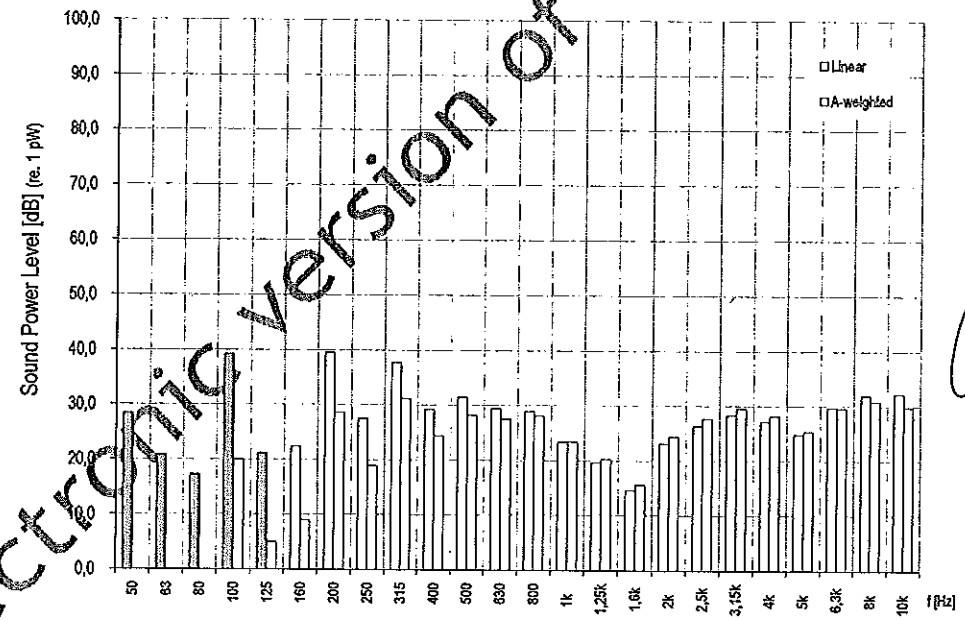
Operation status: NO LOAD	**Table 1**

Frequency [Hz]	50	63	80	100	125	160	200	250	315	400	500	630
$L_{W1/3oct}$ [dB] (ref. 1 pW)	28,5	21,0	17,3	39,2	21,2	22,5	39,6	27,6	37,8	29,3	31,6	29,4
Frequency [Hz]	800	1 k	1,25k	1,6k	2k	2,5k	3,15k	4k	5k	6,3k	8k	10k
$L_{W1/3oct}$ [dB] (ref. 1 pW)	29,0	23,5	19,7	14,7	23,2	26,4	28,4	27,2	24,9	29,7	32,0	32,3

Sound pressure level L_{pf} = **38,0 dB** (ref. 20 µPa)
A-weighted sound pressure level L_{pAf} = **32,7 dB** (ref. 20 µPa)
Environmental correction K_{2A} = **0,3 dB**
Sound power level L_W = **45,5 dB** (ref. 1pW)
A-weighted sound power level L_{WA} = **40,3 dB** (ref. 1pW)



$L_{W1/3\ oct}$	is the sound power level in one-third octave frequency bands, in decibels;
L_W	is the sound power level, in decibels;
L_{WA}	is the A-weighted sound power level, in decibels.
•	background noise too high in this frequency band

The expanded measurement uncertainty of A-weighted sound power level L_{WA}, for a coverage probability of 95% (coverage factor k = 2) as defined in the TPM 0051–93, is 1,2 dB.

the end of a test report

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TECHNICKÝ SKÚŠOBNÝ® ÚSTAV PIEŠŤANY, š.p.
Krajinská cesta 2929/9, 921 01 Piešťany, Slovenská republika

ilac-MRA SNAS Reg. No. 009/S-047

Skúšobne TSÚ - Skúšobňa technickej akustiky a spotrebného tovaru
Tel.: +421-33-7957173, 199 Fax: +421-33-7957172 E-mail: dusan.letko@tsu.sk www.tsu.sk

Test Report
№.: 164000138/2

Name of measurement:	Measurement of airborne noise emission
Name of product:	Transformer
Part Name:	TOHn 339/22
Serial number:	0363132
Specified parameters:	VN: 20000 VAC +/-2x2,5%; NN: 400/231 VAC; 50 Hz; ; 250 kVA;
Manufacturer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Customer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Measurement place:	Semi-anechoic testing room, BEZ Transformátory, a.s., Bratislava
Measurement method:	STN EN ISO 3744; STN EN 60076-10
Order number:	B06/4500005987 / 06.07.2016

Date of issue: 20th July 2016

TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.
Skúšobňa TSÚ
Krajinská cesta 2929/9
92101 PIEŠŤANY
-321-

Tested and elaborated by: Dipl. Ing. Dušan Miklo

Checked and approved by: Dipl. Ing. Dušan Letko
Head of laboratory

Distribution list: 1x – Customer
1x – TSÚ Piešťany, š.p.

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TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.
Krajinská cesta 2929/9, 921 01 Piešťany, Slovenská republika

ilac-MRA SNAS Reg. No. 009/S-047

Skúšobne TSÚ - Skúšobňa technickej akustiky a spotrebného tovaru
Tel.: +421-33-7957173, 199 Fax: +421-33-7957172 E-mail: dusan.letko@tsu.sk www.tsu.sk

Instrumentation used

Name	*Type*	*Serial number*	*Manufacturer*
Microphone	B&K 4189	2741387	Brüel& Kjær, Denmark
Frequency analyser	B&K 2250	2739661	Brüel& Kjær, Denmark
Acoustic calibrator	B&K 4231	2725611	Brüel& Kjær, Denmark
Reference sound source	B&K 4204	680788	Brüel& Kjær, Denmark
Digital logger	ALMEMO 2290-4	H01060898M	AHLBORN, Germany
Thermometer and humidity probe	FH-A646-11	01080716	AHLBORN, Germany
Barometer	FDA612-MA	01080293	AHLBORN, Germany

Instrumentation are metrologically traceable to the standards of accredited calibration laboratory of the Technical Acoustics and Consumer Goods Testing Body in TSU Piestany, s. p. as specified in time intervals in according to quality manual of Testing body.

Measurement method

STN EN ISO 3744 (01 1604) Acoustics. Determination of sound power levels of noise sources using sound pressure. Engineering method in an essentially free field over a reflecting plane.

STN EN 60076 (01 1604) Power transformers. Part 10: Determination of sound levels.

Measurement conditions

– *Date of measurement:* 6th July 2016

– *Atmospheric:* t_0 = 22,9°C; RH = 59,6 %; p_0= 100,1kPa

– *Acoustic:* Free field over a reflecting plane in the semi-anechoic testing room. Averaged background noise level L_{pA}< 18,0 dB.

– *Operation:* Transformer under test was placed on a reflecting plane of the testing space when measured. The transformer was in operating mode without load during the measurement. Supply voltage:3 x 420 VAC / 50 Hz.

– *Measuring:* The microphone positions were evenly situated on measuring line around transformer in height v = 0,435 m over the reflecting plane. Number of measurement points: 16. Height of transformer container: h = 0,87 m. Measuring distance d = 0,3 m. Measurement surface S = 6,26 m^2.

The sound power level L_W and the sound power levels in one-third octave frequency bands $L_{W1/3\ oct}$, shall be calculated as follows

$$L_W = L_{pf} + 10 \cdot \log\left(\frac{S}{S_0}\right) \quad [\text{dB}] \quad (\text{re. } 10^{-12}\ \text{W})$$

where L_{pf} is the surface sound pressure level corrected for background noise and acoustical environment, in decibels (re. 20 µPa);
S is the area of the measurement surface, in square meters; S_0 = 1 m^2;

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TECHNICKÝ SKÚŠOBNÝ® ÚSTAV PIEŠŤANY, š.p.
Krajinská cesta 2929/9, 921 01 Piešťany, Slovenská republika

ilac-MRA SNAS Reg. No. 009/S-047

Skúšobne TSÚ - Skúšobňa technickej akustiky a spotrebného tovaru
Tel.: +421-33-7957173, 199 Fax: +421-33-7957172 E-mail: dusan.letko@tsu.sk www.tsu.sk

Operation status: NO LOAD — **Table 1**

Frequency[Hz]	50	63	80	100	125	160	200	250	315	400	500	630
$L_{W1/3oct}$ [dB] (ref. 1 pW)	24,8	19,5	18,3	41,8	23,6	24,9	44,1	33,0	44,3	33,7	32,2	38,9
Frequency[Hz]	800	1 k	1,25k	1,6k	2k	2,5k	3,15k	4k	5k	6,3k	8k	10k
$L_{W1/3oct}$ [dB] (ref. 1 pW)	34,4	28,0	21,2	24,9	34,2	34,8	31,4	28,9	28,0	25,0	27,6	29,3

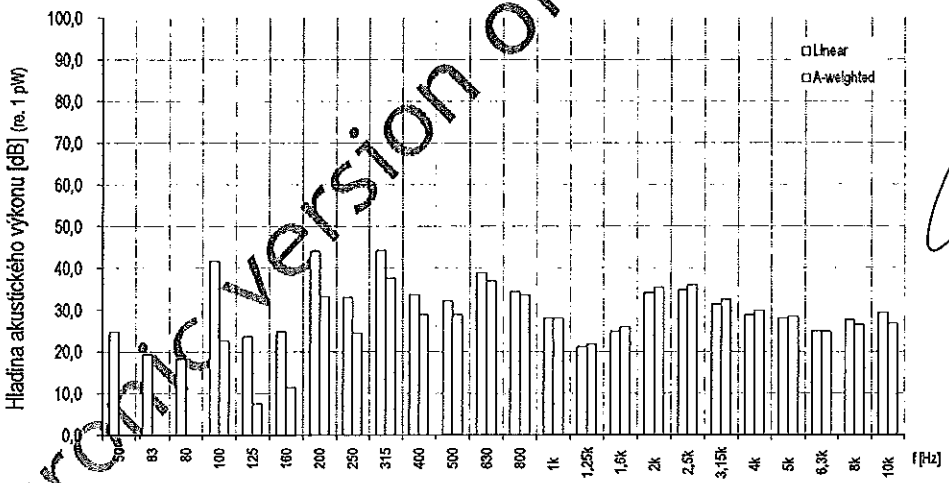
Sound pressure level L_{pf} = **41,8** (ref. 20 µPa)

A-weighted sound pressure level L_{pAf} = **36,9 dB** (ref. 20 µPa)

Environmental correction K_{2A} = **0,3 dB**

Sound power level L_W = **49,8 dB** (ref. 1pW)

A-weighted sound power level L_{WA} = **44,9 dB** (ref. 1pW)



$L_{W1/3oct}$ is the sound power level in one-third octave frequency bands, in decibels;
L_W is the sound power level, in decibels;
L_{WA} is the A-weighted sound power level, in decibels.
background noise too high in this frequency band

The expanded measurement uncertainty of A-weighted sound power level L_{WA}, for a coverage probability of 95% (coverage factor k = 2) as defined in the TPM 0051–93, is 1,2 dB.

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Test Report
№.: 164000138/3

Name of measurement:	Measurement of airborne noise emission
Name of product:	Transformer
Part Name:	TOHn 359/22
Serial number:	0363336
Specified parameters:	VN: 20000 VAC +/-2x2,5%; NN: 400/231 VAC; 50 Hz; ; 400 kVA;
Manufacturer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Customer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Measurement place:	Semi-anechoic testing room, BEZ Transformátory, a.s., Bratislava
Measurement method:	STN EN ISO 3744; STN EN 60076-10
Order number:	B06/4500005987 / 06.07.2016

Date of issue: 20th July 2016

TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.
Skúšobňa TSÚ
Krajinská cesta 2929/9
92101 PIEŠŤANY
-321-

Tested and elaborated by: Dipl. Ing. Dušan Miklo

Checked and approved by: Dipl. Ing. Dušan Letko
Head of laboratory

Distribution list: 1x – Customer
1x – TSÚ Piešťany, š.p.

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TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.
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Tel.: +421-33-7957173, 199 Fax: +421-33-7957172 E-mail: dusan.letko@tsu.sk www.tsu.sk

Instrumentation used

Name	*Type*	*Serial number*	*Manufacturer*
Microphone	B&K 4189	2741387	Brüel& Kjær, Denmark
Frequency analyser	B&K 2250	2739661	Brüel& Kjær, Denmark
Acoustic calibrator	B&K 4231	2725611	Brüel& Kjær, Denmark
Reference sound source	B&K 4204	680788	Brüel& Kjær, Denmark
Digital logger	ALMEMO 2290-4	H01060898M	AHLBORN, Germany
Thermometer and humidity probe	FH-A646-11	01080716	AHLBORN, Germany
Barometer	FDA612-MA	01080293	AHLBORN, Germany

Instrumentation are metrologically traceable to the standards of accredited calibration laboratory of the Technical Acoustics and Consumer Goods Testing Body in TSU Piestany, s.p. as specified in time intervals in according to quality manual of Testing body.

Measurement method

STN EN ISO 3744 (01 1604) Acoustics. Determination of sound power levels of noise sources using sound pressure. Engineering method in an essentially free field over a reflecting plane.

STN EN 60076 (01 1604) Power transformers. Part 10: Determination of sound levels.

Measurement conditions

– *Date of measurement:* 6th July 2016

– *Atmospheric*: t_0 = 22,9°C; RH = 59,6 %; p_0= 100,1kPa

– *Acoustic:* Free field over a reflecting plane in the semi-anechoic testing room. Averaged background noise level L_{pA}< 18,0 dB.

– *Operation*: Transformer under test was placed on a reflecting plane of the testing space when measured. The transformer was in operating mode without load during the measurement. Supply voltage:3 x 420 VAC / 50 Hz.

– *Measuring:* The microphone positions were evenly situated on measuring line around transformer in height v = 0,475 m over the reflecting plane. Number of the measurement points: 16. Height of transformer container: h = 0,95 m. Measuring distance d = 0,3 m. Measurement surface S = 7,41 m^2.

The sound power level L_W and the sound power levels in one-third octave frequency bands $L_{W1/3\ oct}$, shall be calculated as follows

$$L_W = L_{pf} + 10 \cdot \log\left(\frac{S}{S_0}\right) \quad [dB] \quad (\text{re. } 10^{-12}\ W)$$

where L_{pf} is the surface sound pressure level corrected for background noise and acoustical environment, in decibels (re. 20 μPa);
S is the area of the measurement surface, in square meters; S_0 = 1 m^2 ;

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Tel.: +421-33-7957173, 199 Fax: +421-33-7957172 E-mail: dusan.letko@tsu.sk www.tsu.sk

Operation status: NO LOAD — **Table 1**

Frequency[Hz]	50	63	80	100	125	160	200	250	315	400	500	630
$L_{W1/3oct}$ [dB] (ref. 1 pW)	30,3	26,3	22,8	43,0	25,6	21,0	38,2	31,1	44,8	34,9	32,4	39,7
Frequency[Hz]	800	1 k	1,25k	1,6k	2k	2,5k	3,15k	4k	5k	6,3k	8k	10k
$L_{W1/3oct}$ [dB] (ref. 1 pW)	38,5	25,7	22,5	25,5	32,7	33,4	30,1	27,4	25,7	25,1	25,8	26,2

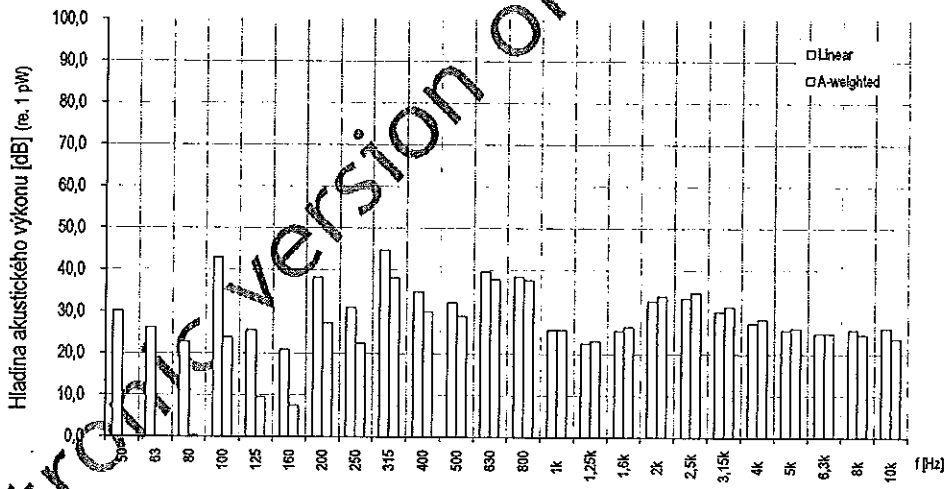
Sound pressure level L_{pf} = **40,8** (ref. 20 µPa)

A-weighted sound pressure level L_{pAf} = **36,2 dB** (ref. 20 µPa)

Environmental correction K_{2A} = **0,3 dB**

Sound power level L_W = **49,5 dB** (ref. 1pW)

A-weighted sound power level L_{WA} = **44,9 dB** (ref. 1pW)



$L_{W1/3oct}$ is the sound power level in one-third octave frequency bands, in decibels;
L_W is the sound power level, in decibels;
L_{WA} is the A-weighted sound power level, in decibels.
background noise too high in this frequency band

The expanded measurement uncertainty of A-weighted sound power level L_{WA}, for a coverage probability of 95% (coverage factor k = 2) as defined in the TPM 0051–93, is 1,2 dB.

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Test Report №.: 164000207/4

Name of measurement:	Measurement of airborne noise emission
Name of product:	Transformer
Part Name:	TOHn 379/22
Serial number:	0363137
Specified parameters:	VN: 20000 VAC +/-2x2,5%; NN: 400/231 VAC; 50 Hz; ; 630 kVA;
Manufacturer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Customer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Measurement place:	Semi-anechoic testing room, BEZ Transformátory, a.s., Bratislava
Measurement method:	STN EN ISO 3744; STN EN 60076-10
Order number:	B06/4500006783 / 03.10.2016

Date of issue: 10h October 2016

TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.
Skúšobňa TSÚ
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92101 PIEŠŤANY
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Tested and elaborated by:
Dipl. Ing. Dušan Miklo
Test Engineer

Checked and approved by:
Dipl. Ing. Tomáš Bednárik
Technical Head

Distribution list: 1x – Customer
1x – TSÚ Piešťany, š.p.

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Instrumentation used

Name	*Type*	*Serial number*	*Manufacturer*
Microphone	B&K 4189	2741387	Brüel& Kjær, Denmark
Frequency analyser	B&K 2250	2739661	Brüel& Kjær, Denmark
Acoustic calibrator	B&K 4231	2725611	Brüel& Kjær, Denmark
Reference sound source	B&K 4204	680788	Brüel& Kjær, Denmark
Digital logger	ALMEMO 2290-4	H01060898M	AHLBORN, Germany
Thermometer and humidity probe	FH-A646-11	01080716	AHLBORN, Germany
Barometer	FDA612-MA	01080293	AHLBORN, Germany

Instrumentation are metrologically traceable to the standards of accredited metrological laboratory in TSU Piestany, s. p. as specified in time intervals in according to quality manual of Testing body.

Measurement method

STN EN ISO 3744 (01 1604) Acoustics. Determination of sound power levels of noise sources using sound pressure. Engineering method in an essentially free field over a reflecting plane.

STN EN 60076 (01 1604) Power transformers. Part 10: Determination of sound levels.

Measurement conditions

– *Date of measurement:* 29. 09. 2016

– *Atmospheric:* t_0 = (20,1 – 21,1) °C; RH = (49,2 – 49,7) %; p_0= (100,1 – 100,3) kPa

– *Acoustic:* Free field over a reflecting plane in the semi-anechoic testing room. Averaged background noise level L_{pA}< 17,0 dB.

– *Operation:* Transformer under test was placed on a reflecting plane of the testing space when measured. The transformer was in operating mode without load during the measurement. Supply voltage:3 x 400 VAC / 50 Hz.

– *Measuring:* The microphone positions were evenly situated on measuring line around transformer in height v = 0,50 m over the reflecting plane. Number of the measurement points: 16. Height of transformer container: h = 1,00 m. Measuring distance d = 0,3 m. Measurement surface S = 8,20 m^2.

The sound power level L_W and the sound power levels in one-third octave frequency bands $L_{W1/3\,oct}$, shall be calculated as follows

$$L_W = L_{pf} + 10 \cdot \log\left(\frac{S}{S_0}\right) \quad [dB] \quad (re.\ 10^{-12}\ W)$$

where L_{pf} is the surface sound pressure level corrected for background noise and acoustical environment, in decibels (re. 20 µPa);
S is the area of the measurement surface, in square meters; S_0 = 1 m^2 ;

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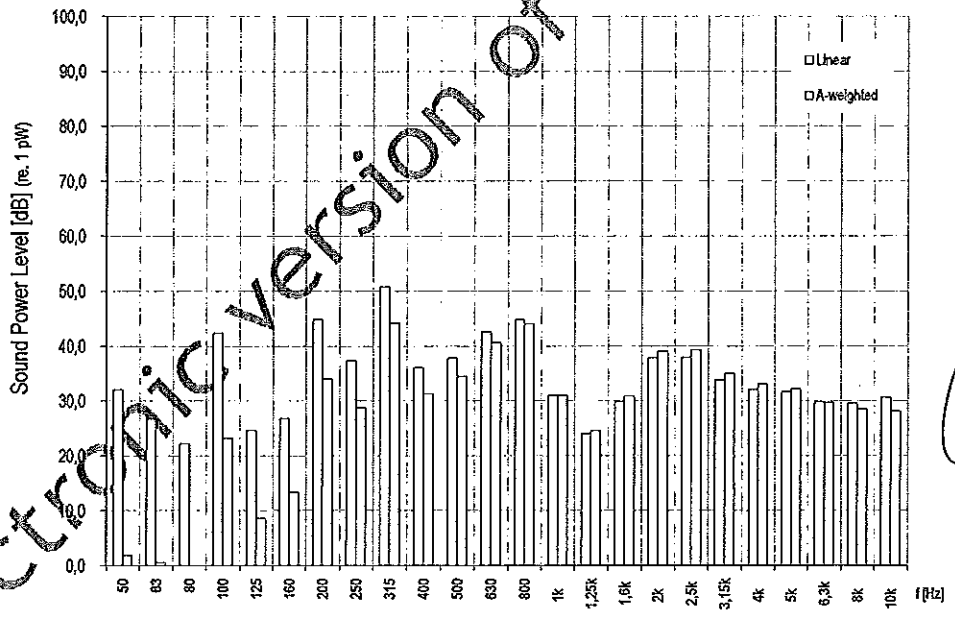
Operation status: NO LOAD	**Table 1**

Frequency [Hz]	50	63	80	100	125	160	200	250	315	400	500	630
$L_{W1/3oct}$ [dB] (ref. 1 pW)	32,1	26,8	22,3	42,4	24,8	26,8	44,9	37,4	50,8	36,1	37,9	42,6
Frequency [Hz]	800	1 k	1,25k	1,6k	2k	2,5k	3,15k	4k	5k	6,3k	8k	10k
$L_{W1/3oct}$ [dB] (ref. 1 pW)	44,9	31,0	24,1	29,9	37,9	38,0	33,9	32,2	31,8	29,9	29,6	30,7

Sound pressure level L_{pf} = **45,0 dB** (ref. 20 µPa)
A-weighted sound pressure level L_{pAf} = **40,9 dB** (ref. 20 µPa)
Environmental correction K_{2A} = **0,3 dB**
Sound power level L_W = **54,2 dB** (ref. 1pW)
A-weighted sound power level L_{WA} = **50,0 dB** (ref. 1pW)



$L_{W1/3\ oct}$	is the sound power level in one-third octave frequency bands, in decibels;
L_W	is the sound power level, in decibels;
L_{WA}	is the A-weighted sound power level, in decibels.
•	background noise too high in this frequency band

The expanded measurement uncertainty of A-weighted sound power level L_{WA}, for a coverage probability of 95% (coverage factor k = 2) as defined in the TPM 0051–93, is 1,2 dB.

the end of a test report

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Test Report №.: 164000207/2

Name of measurement:	Measurement of airborne noise emission
Name of product:	Transformer
Part Name:	TOHn 389/22
Serial number:	0361831
Specified parameters:	VN: 20000 VAC +/-2x2,5%; NN: 400/231 VAC; 50 Hz; ; 800 kVA;
Manufacturer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Customer:	BEZ Transformátory, a.s., Rybničná 40, SK - 835 54 Bratislava
Measurement place:	Semi-anechoic testing room, BEZ Transformátory, a.s., Bratislava
Measurement method:	STN EN ISO 3744; STN EN 60076-10
Order number:	B06/4500006783 / 03.10.2016

Date of issue: 10h October 2016

TECHNICKÝ SKÚŠOBNÝ ÚSTAV PIEŠŤANY, š.p.
Skúšobňa TSÚ
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Tested and elaborated by:
Dipl. Ing. Dušan Miklo
Test Engineer

Checked and approved by:
Dipl. Ing. Tomáš Bednárik
Technical Head

Distribution list: 1x – Customer
1x – TSÚ Piešťany, š.p.

T-10-13/1.0

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Instrumentation used

Name	*Type*	*Serial number*	*Manufacturer*
Microphone	B&K 4189	2741387	Brüel& Kjær, Denmark
Frequency analyser	B&K 2250	2739661	Brüel& Kjær, Denmark
Acoustic calibrator	B&K 4231	2725611	Brüel& Kjær, Denmark
Reference sound source	B&K 4204	680788	Brüel& Kjær, Denmark
Digital logger	ALMEMO 2290-4	H01060898M	AHLBORN, Germany
Thermometer and humidity probe	FH-A646-11	01080716	AHLBORN, Germany
Barometer	FDA612-MA	01080293	AHLBORN, Germany

Instrumentation are metrologically traceable to the standards of accredited metrological laboratory in TSU Piestany, s. p. as specified in time intervals in according to quality manual of Testing body.

Measurement method

STN EN ISO 3744 (01 1604) Acoustics. Determination of sound power levels of noise sources using sound pressure. Engineering method in an essentially free field over a reflecting plane.

STN EN 60076 (01 1604) Power transformers. Part 10: Determination of sound levels.

Measurement conditions

– *Date of measurement:* 29. 09. 2016

– *Atmospheric*: t_0 = (20,1 – 21,1) °C; RH = (49,2 – 49,7) %; p_0= (100,1 – 100,3) kPa

– *Acoustic:* Free field over a reflecting plane in the semi-anechoic testing room. Averaged background noise level L_{pA}< 17,0 dB.

– *Operation*: Transformer under test was placed on a reflecting plane of the testing space when measured. The transformer was in operating mode without load during the measurement. Supply voltage:3 x 400 VAC / 50 Hz.

– *Measuring:* The microphone positions were evenly situated on measuring line around transformer in height v = 0,51 m over the reflecting plane. Number of the measurement points: 16. Height of transformer container: h = 1,02 m. Measuring distance d = 0,3 m. Measurement surface S = 9,18 m^2.

The sound power level L_W and the sound power levels in one-third octave frequency bands $L_{W1/3\ oct}$, shall be calculated as follows

$$L_W = L_{pf} + 10 \cdot \log\left(\frac{S}{S_0}\right) \quad [dB] \quad (re.\ 10^{-12}\ W)$$

where L_{pf} is the surface sound pressure level corrected for background noise and acoustical environment, in decibels (re. 20 µPa);
S is the area of the measurement surface, in square meters; S_0 = 1 m^2;

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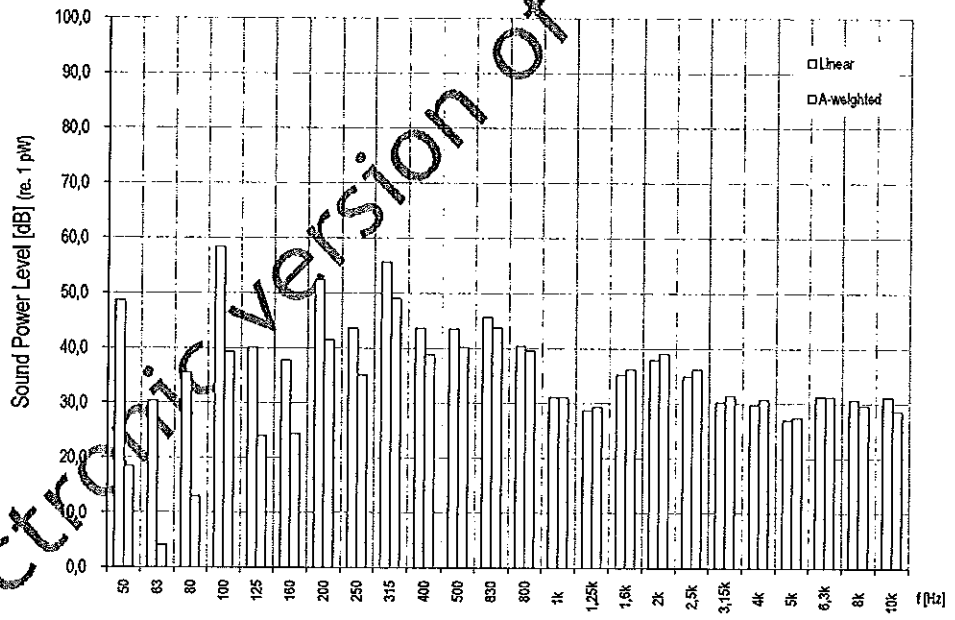
Operation status: NO LOAD	**Table 1**

Frequency [Hz]	50	63	80	100	125	160	200	250	315	400	500	630
$L_{W1/3oct}$ [dB] (ref. 1 pW)	48,7	30,4	35,5	58,4	40,2	37,8	52,5	43,7	55,7	43,6	43,5	45,7
Frequency [Hz]	800	1 k	1,25k	1,6k	2k	2,5k	3,15k	4k	5k	6,3k	8k	10k
$L_{W1/3oct}$ [dB] (ref. 1 pW)	40,4	31,1	28,8	35,2	37,9	34,9	30,3	29,8	27,0	31,3	30,7	31,1

Sound pressure level L_{pf} = **52,1 dB** (ref. 20 µPa)
A-weighted sound pressure level L_{pAf} = **43,0 dB** (ref. 20 µPa)
Environmental correction K_{2A} = **0,3 dB**
Sound power level L_W = **61,7 dB** (ref. 1pW)
A-weighted sound power level L_{WA} = **52,6 dB** (ref. 1pW)



$L_{W1/3\ oct}$	is the sound power level in one-third octave frequency bands, in decibels;
L_W	is the sound power level, in decibels;
L_{WA}	is the A-weighted sound power level, in decibels.
•	background noise too high in this frequency band

The expanded measurement uncertainty of A-weighted sound power level L_{WA}, for a coverage probability of 95% (coverage factor k = 2) as defined in the TPM 0051–93, is 1,2 dB.

the end of a test report

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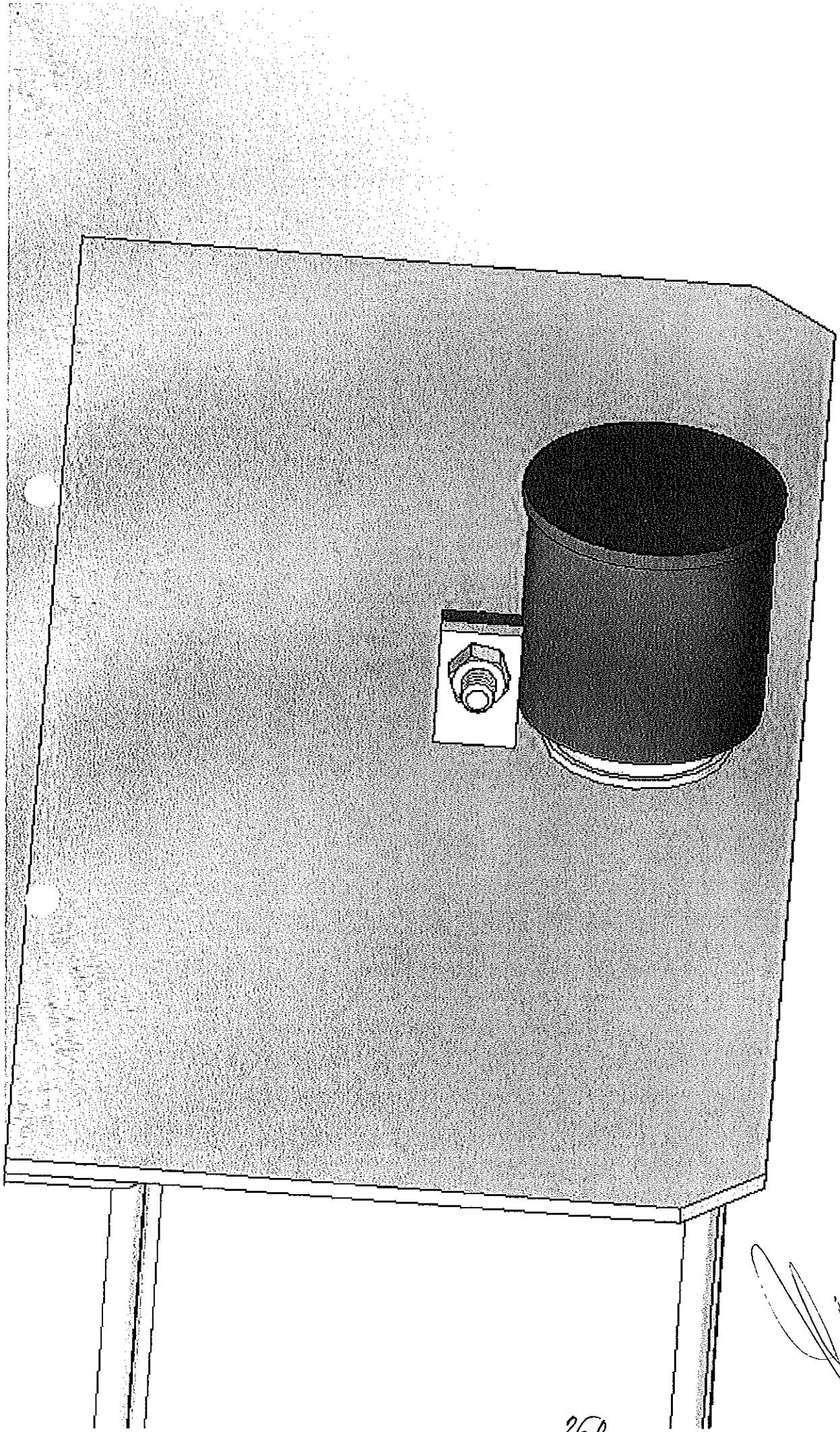
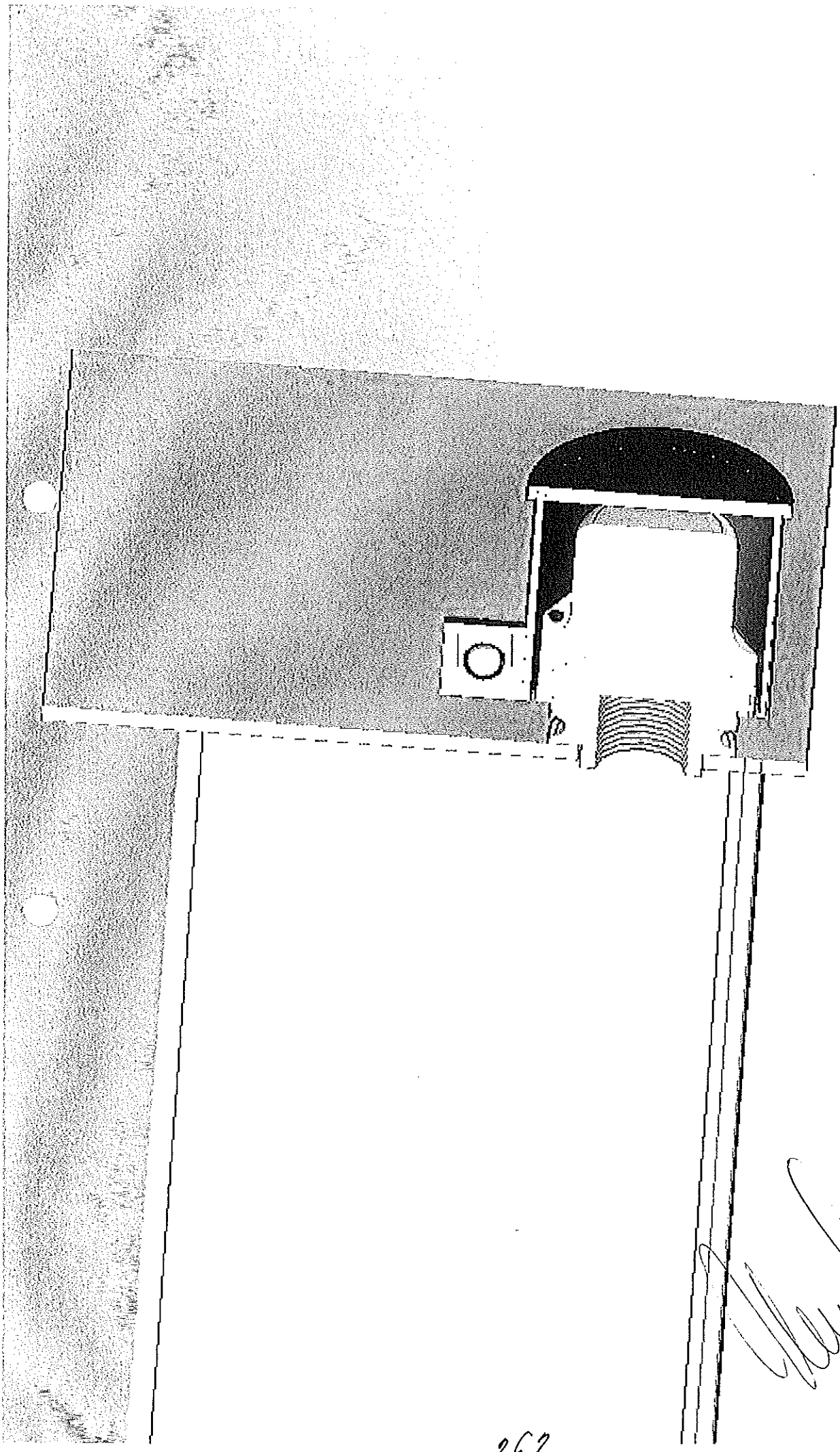
Приложение № 9

Изпускателен вентил със защита от неправомерно отваряне





КОЛИЧЕСТВА СЪС СРОК НА ДОСТАВКА И ОПАКОВКА

ОБОСОБЕНА ПОЗИЦИЯ 2
1/ Количества със срок на доставка

№	Наименование на материал	Минимален размер на партида, бр.	Количества със срок на доставка в рамките на 1 (един) календарен месец, бр.
1	2	3	4
1	Трифазен маслонапълнен разпределителен херметизиран трансформатор 10/0,4kV, 250 kVA, с комбинирано защитно реле	1	1
2	Трифазен маслонапълнен разпределителен херметизиран трансформатор 10/0,4kV, 400 kVA, с комбинирано защитно реле	1	1
3	Трифазен маслонапълнен разпределителен херметизиран трансформатор 10/0,4kV, 630 kVA, с комбинирано защитни реле	1	1
4	Трифазен маслонапълнен разпределителен херметизиран трансформатор 10/0,4kV, 800 kVA, с комбинирано защитно реле	1	1
5	Трифазен маслонапълнен разпределителен херметизиран трансформатор 10/0,4kV, 250 kVA, с нивопоказател	1	1
6	Трифазен маслонапълнен разпределителен херметизиран трансформатор 10/0,4kV, 400 kVA, с нивопоказател	1	1
7	Трифазен маслонапълнен разпределителен херметизиран трансформатор 10/0,4kV, 630 kVA, с нивопоказател	1	1
8	Трифазен маслонапълнен разпределителен херметизиран трансформатор 10/0,4kV, 800 kVA, с нивопоказател	1	2
9	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 250 kVA, с комбинирано защитно реле	1	1
10	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 400 kVA, с комбинирано защитно реле	1	1
11	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 630 kVA, с комбинирано защитно реле	1	1
12	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 800 kVA, с комбинирано защитно реле	1	1
13	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 50 kVA, с нивопоказател	1	1
14	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 100 kVA, с нивопоказател	1	2
15	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 160 kVA, с нивопоказател	1	3
16	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 250 kVA, с нивопоказател	1	2
17	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 400 kVA, с нивопоказател	1	2
18	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 630 kVA, с нивопоказател	1	2
19	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 800 kVA, с нивопоказател	1	2

BEZ TRANSFORMÁTORY, a.s.
Predaj
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835 54 Bratislava
(1)

Дата 08.11. г. 2016

ПОДПИС и ПЕЧАТ:

(име и фамилия) Юрий Шкатин, Ерик Ко...
Председател и член на Управителния съвет
(длъжност на представляващия участника)

2/ ОПАКОВКА /Колони от 4 до 7 се попълват от участника/
ОБОСОБЕНА ПОЗИЦИЯ 2

№	Наименование на материал	Минимален размер на партида	Вид опаковка	Брой на стоката в опаковка	Размери на опаковката в см /Д х В х Ш/	Бруто тегло, кг.
1	2	3	4	5	6	7
1	Трифазен маслонапълнен разпределителен херметизиран трансформатор 10/0,4kV, 250 kVA, с комбинирано защитно реле	1	на дървен блок	1	96x72x120	935
2	Трифазен маслонапълнен разпределителен херметизиран трансформатор 10/0,4kV, 400 kVA, с комбинирано защитно реле	1	"	1	103x83x127	1290
	Трифазен маслонапълнен разпределителен херметизиран трансформатор 10/0,4kV, 630 kVA, с комбинирано защитни реле	1	"	1	130x83x129	1605
4	Трифазен маслонапълнен разпределителен херметизиран трансформатор 10/0,4kV, 800 kVA, с комбинирано защитно реле	1	"	1	151x90x140	2110
5	Трифазен маслонапълнен разпределителен херметизиран трансформатор 10/0,4kV, 250 kVA, с нивопоказател	1	"	1	96x72x120	935
6	Трифазен маслонапълнен разпределителен херметизиран трансформатор 10/0,4kV, 400 kVA, с нивопоказател	1	"	1	103x 83x127	1290
7	Трифазен маслонапълнен разпределителен херметизиран трансформатор 10/0,4kV, 630 kVA, с нивопоказател	1	"	1	130x83x129	1605
8	Трифазен маслонапълнен разпределителен херметизиран трансформатор 10/0,4kV, 800 kVA, с нивопоказател	1	"	1	151x90x140	2110
9	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 250 kVA, с комбинирано защитно реле	1	"	1	96x72x131	935
10	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 400 kVA, с комбинирано защитно реле	1	"	1	103x83x138	1285
11	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 630 kVA, с комбинирано защитно реле	1	"	1	130x83x140	1605
12	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 800 kVA, с комбинирано защитно реле	1	"	1	151x90x151	2110
13	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 50 kVA, с нивопоказател	1	"	1	83x58x131	510
14	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 100 kVA, с нивопоказател	1	"	1	92x67x126	765
15	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 160 kVA, с нивопоказател	1	"	1	93x68x129	850
16	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 250 kVA, с нивопоказател	1	"	1	96x72x131	935
17	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 400 kVA, с нивопоказател	1	"	1	103x83x138	1290
18	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 630 kVA, с нивопоказател	1	"	1	130x83x140	1605
19	Трифазен маслонапълнен разпределителен херметизиран трансформатор 20/0,4kV, 800 kVA, с нивопоказател	1	"	1	151x90x151	2110

Дата 08.11. г. 2016

ПОДПИС и ПЕЧАТ: Юрай Шнатчик, Ерик Моке
(име и фамилия)

Председател и член на Управителния съвет
(длъжност на представляващия участника)

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L 1526

Total sheets: 14

Test Report

AP_EZ/2016/049/01/EN

Customer:	BEZ TRANSFORMÁTORY a.s. Rybničná 40 835 54 Bratislava		
Tested object:	**Transformer TOHn 359/22, s.n. 0363336**		
Test take over date:	September 23th , 2016		
Test realization date:	September 28th , 2016		
Test identification No.:	365-302-1624	**Evidentiary No:**	48/2016
Order No:	B06/4500006720		

Testing methods, regulations:

ACCREDITED TESTS ACCORDING TO SOP_EZ/2, 4, 6 and 8:

ČSN EN 60076-1, Clause 11.2	Measurement of winding resistance
ČSN EN 60076-1, Clause 11.4	Measurement of short-circuit impedance and load loss
ČSN EN 60076-1, Clause 11.5	Measurement of no-load loss and current
ČSN EN 60076-2 ed.2	Power transformer – Part 2: Temperature rise for liquid-immersed transformers
ČSN EN 60076-3 ed.2, Clause 13.2	Full wave lightning impulse test (LI)

Test results: In the text.

Enclosures: --

In Plzeň, 30th September 2016

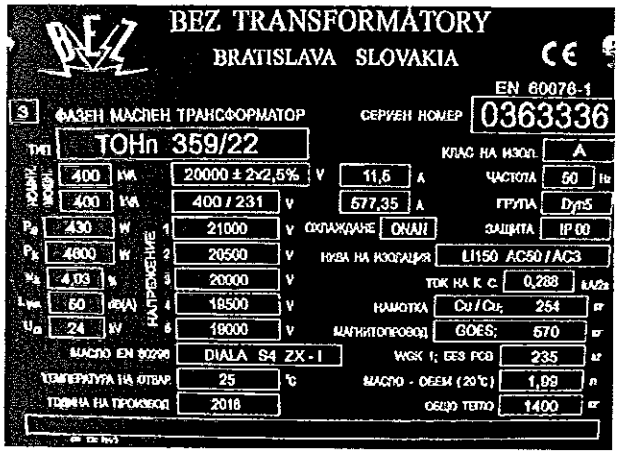
Petr Šíma
Electrical Testing Laboratory Director

Test Report is issued in 3 copies – 2 are obtained by the customer and 1 is kept in the Laboratory.
Test Report is issued for the customer in electronic form too.

Contents

Tested object

Oil-immersed transformer TOHn 359/22.



Performed tests

Routine tests:

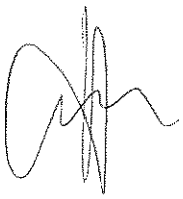
- Measurement of winding resistance according to the Standard ČSN EN 60076-1, Clause 11.2. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of short-circuit impedance and load loss according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer.
- Measurement of no-load loss and current according to the Standard ČSN EN 60076-1, Clause 11.5. The test was carried out at main tap of the tested transformer.

Type tests:

- Temperature rise test according to the Standard ČSN EN 60076-2 ed.2 at tapping 3 of the tested transformer with ratio 20/0.4 kV.
- Full wave lightning impulse test (LI) of the tested transformer according to the Standard ČSN EN 60076-3 ed.2, Clause 13.2. Test was carried out at HV side with negative wave 150 kV.

Used apparatuses

Name	Type	Filing No.
Digital multimeter	Fluke 189	PMMm 263
Digital multimeter	Fluke 179	PMMm 269
Digital oscilloscope	AT DSO7034A	PMMo 265
Digital oscilloscope	Keysight DSO-X 4034A	PMMo 270
Isolating converters	BB3652	PMMp 254
Mercury thermometer	from 0°C to 50°C	PMMt 239
Digital thermometer	GMH 3710	PMMt 268
Current transformer	ABB Petercem EA100	PMTr 92
Current transformer	ABB Petercem EA100	PMTr 93
Current transformer	ABB Petercem EA100	PMTr 94
Three-phase power analyzer	D6100	PMWa 19
Power analyzer	Norma 5000	PMWa 27
Impulse Analyzing System	HiAS 743	176736



Measurement of winding resistance

Description

The measurement of winding resistance was performed according to the Standard ČSN EN 60076-1, Clause 11.2.3. Measurement was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Winding resistances each of above mentioned tappings were measured with DC current, with Ohm's method, between terminals of each phase on HV side of transformer and between node and terminal of respective phase on LV side of tested transformer. The mean temperature of cooling liquid (temperature of transformer winding) was measured during the test. Temperature was between 22.3 °C and 22.7 °C. Resulting value of the resistance was recalculated to 75 °C.

Results

Resistances of transformer winding are noted in **Tab. 1.**

Side of transformer	Tap	Terminal	Before type and special tests	
			$R_{measured}$ (Ω)	R_{75} (Ω)
HV	1 (+ 5 %)	1U – 1V	9.636676126	11.61045316
		1U – 1W	9.680634743	11.66341535
		1V – 1W	9.660335285	11.63895817
	3 (0 %)	1U – 1V	9.129011656	10.99880922
		1U – 1W	9.165738826	11.04305883
		1V – 1W	9.155209410	11.03037278
	5 (- 5 %)	1U – 1V	8.623641358	10.38992935
		1U – 1W	8.662324251	10.43653524
		1V – 1W	8.598903282	10.36012444
LV		2n – 2u	0.001932286	0.002326247
		2n – 2v	0.001916093	0.002307650
		2n – 2w	0.001916987	0.002308726

Tab. 1: Resistances of transformer winding.

Measurement of short-circuit impedance and load loss

Description

Measurement of short-circuit impedance and load loss was performed according to the Standard ČSN EN 60076-1, Clause 11.4. The test was carried out at tappings 1, 3 and 5 of the tested transformer in temperature steady state.

Voltage was applied to HV terminals of the transformer, LV terminals were short circuited. Supply current of 50 Hz was ca. 4 A. Temperature was 22.5 °C.

Measured values of short-circuit impedance and load loss were corrected for the reference temperature 75 °C.

Results

Measured values of short-circuit impedance and load loss are noted in **Tab. 2.**